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FEBRUARY 19, 1960

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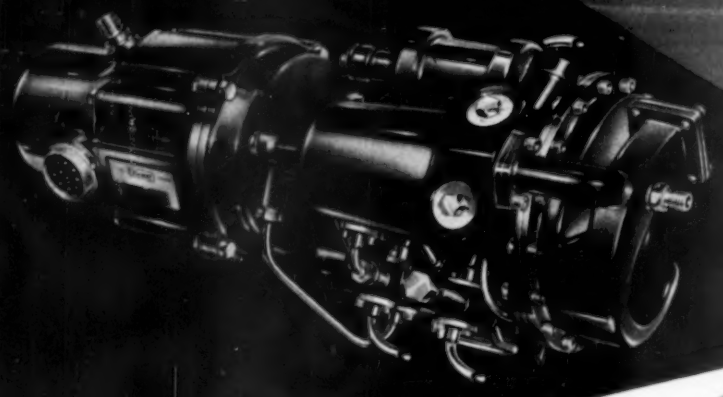

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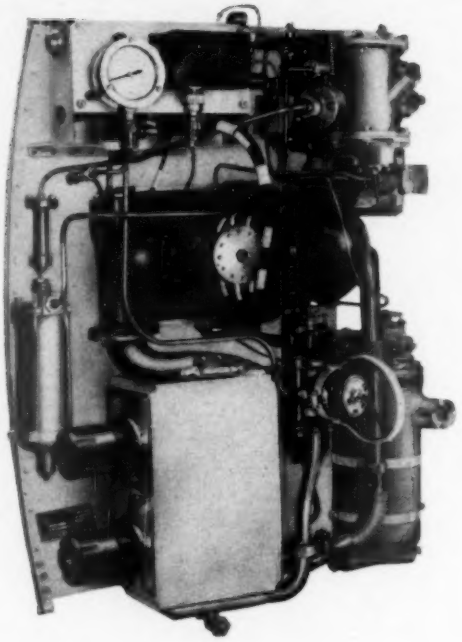

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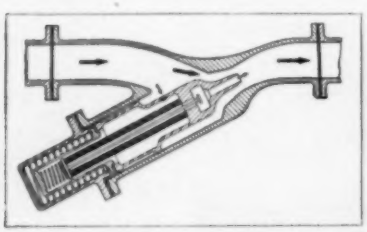

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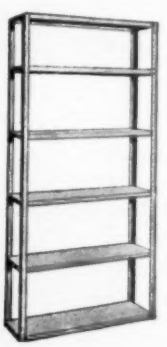

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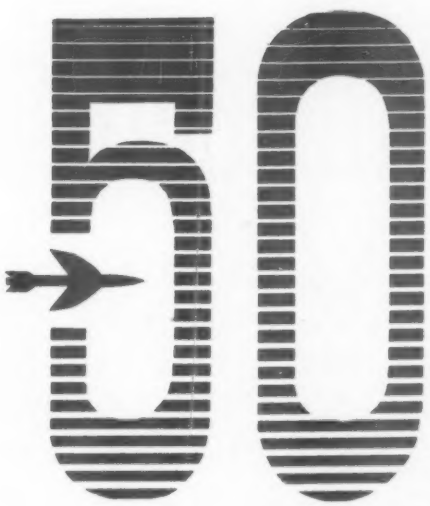

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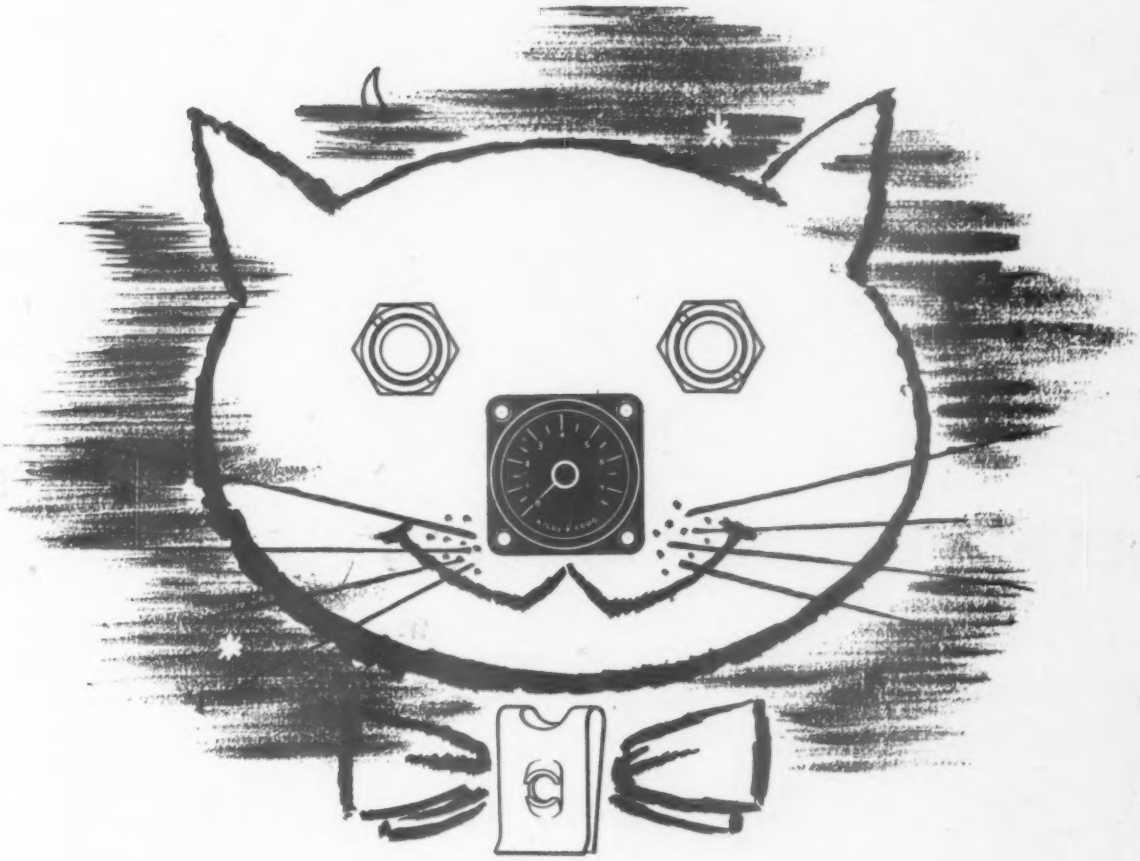

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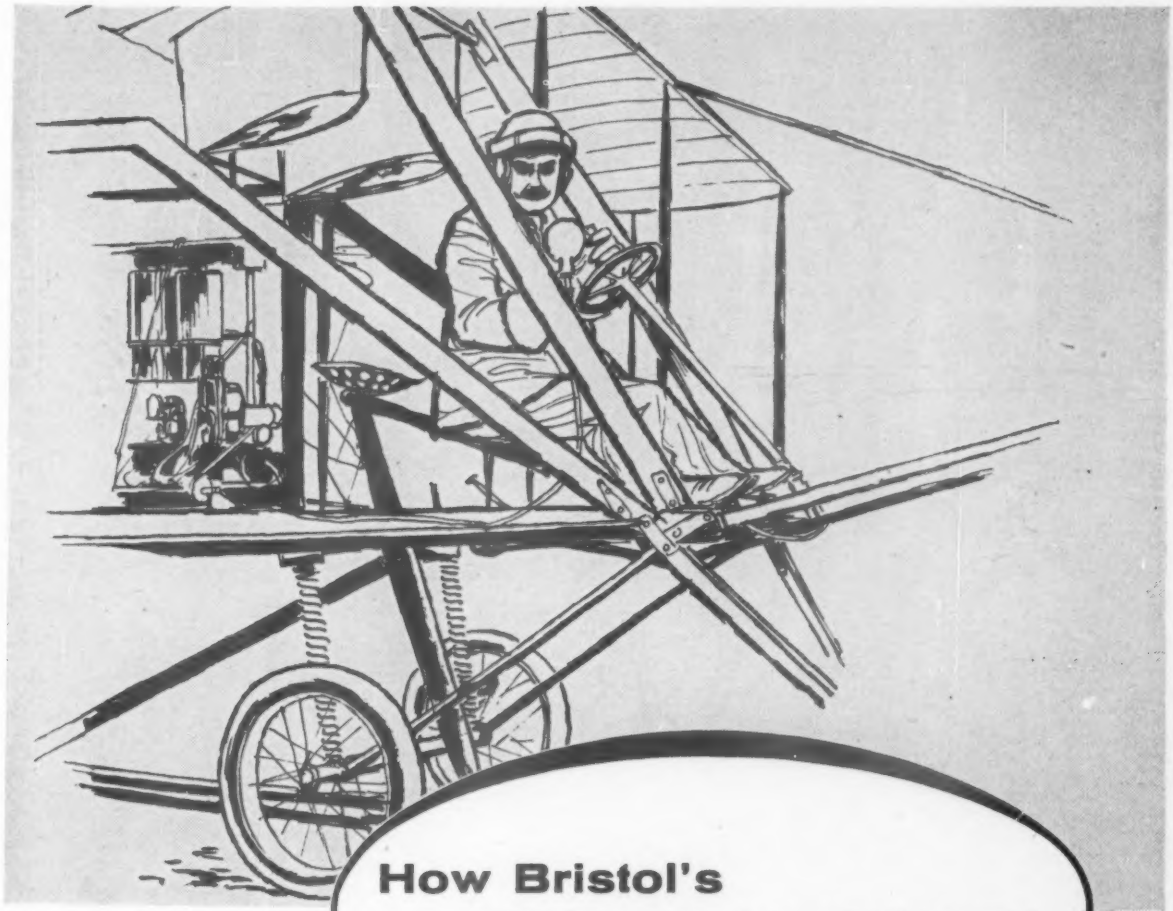

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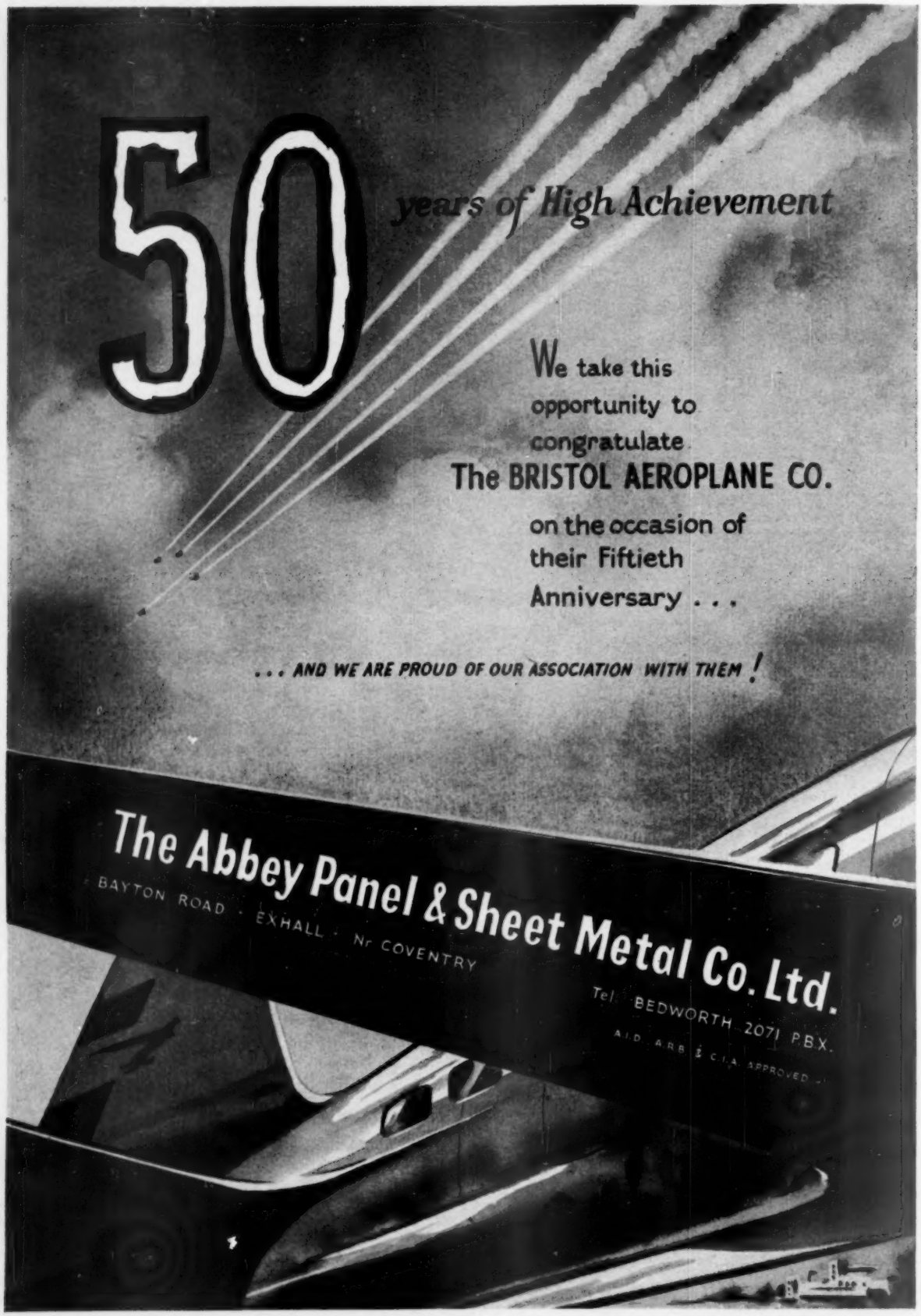
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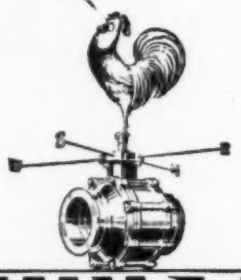

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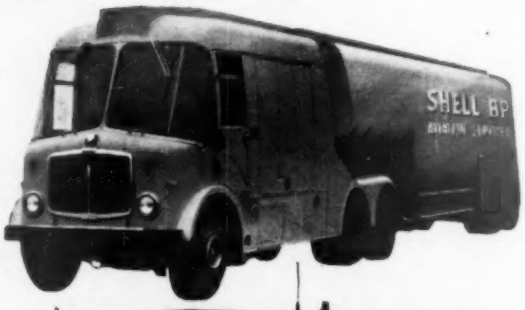

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Looking back over the Company's many notable achievements, we take pride on our 50th Anniversary in saluting our founder, and all whose enthusiasm and resourcefulness have made the name of **Bristol** celebrated in aviation.

THE AEROPLANE and ASTRONAUTICS

VOLUME 98 NUMBER 2522 FEBRUARY 19, 1960

Leaving Genius Unfettered

Now that our new Minister of Aviation has said that the Government consider that the British aircraft industry is a good thing and must be supported at all stages in the conception and production and proving of civil aircraft, we can at least have some hope that the truly remarkable contribution of the industry to the export earnings of the United Kingdom will not be unduly depressed over the next few years.

Mr. Sandys made it clear that the contraction of the industry into five main groups was his responsibility. We trust that he will keep in mind the difficulties that arise in making the best use of genius in very big organizations. None of us can afford to overlook the fact that it is many years since Sir Frank Whittle gave up his connection with the organization that brought the British gas turbine into being. After designing the Canberra, Mr. W. E. W. Petter left the company building it to develop the lightweight fighter. The organization he built up to do this has been merged; it is true that the success of Mr. Petter's work may be measured by the placing of a Government order for his design, but Mr. Petter has left the industry.

If progress is not to be fettered, some way of ensuring the utilization of genius must be secured.

International Collaboration

Those of us who have grown up in aviation know that it is a global business and as such all its affairs have to get themselves on an international basis. Hitherto, for fairly obvious reasons, the actual manufacture of aircraft, as opposed to their sale, has been a nationalistic business.

Signs of a change were to be discerned when Fairchild in the United States bought a licence to manufacture the Friendship in parallel with Fokker in Holland. In this country the long and successful association of Westland Aircraft with the Sikorsky division of United Aircraft comes to mind at once. Germany is building a number of French designs under licence and, in common with other European countries, is soon to build a U.S. fighter. This growing U.S. collaboration with the industries of other countries became headline news last week with the announcement of an agreement between France's Sud Aviation, manufacturers of the Caravelle, and Douglas Aircraft. It had been known that the French had been hopeful of establishing such a link with a British manufacturer.

Constructional capacity of Sud is limited; figures of as low as four Caravelles a month have been mentioned. Thus even to reach as low a figure as a hundred Caravelles a year, capacity to build another five per month will have to be found. And a very nice production job that would be for some factories we can think of. On the other hand, Douglas will probably regard five a month as chickenfeed. Mr. Douglas, Jnr., has been quoted as saying that whether his company would produce would depend on whether substantial orders were to be placed. From the figure of orders for 300 Caravelles over the next three or four years, mentioned by Mr. Douglas, it seems that the Douglas minimum figure might be 10 per month.

We can hardly believe that such successful competitors of Douglas as the Boeing Company will not react to what we might describe as hedging in the short/medium range jet market. It would be interesting if they were to go for licences for the D.H. 121 or Vickers VC 11.

Editor - - - - - THURSTAN JAMES
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Matters of Moment

Joining the Folland Board

EARLIER this year it was announced that Mr. M. J. Brennan, B.Sc., M.I.Mech.E., F.R.Ae.S., had joined Hawker Siddeley Aviation to become chief engineer of Folland Aircraft—which company the Hawker Siddeley Group had acquired some time previously. From the Group now comes the news that Mr. Brennan has been appointed to the Folland board.

As one of the aircraft industry's outstanding dynamic design personalities, Maurice Brennan takes to his new post a wealth of experience in a wide variety of aeronautical fields. Born in April, 1913, he was educated at Glasgow University where he took his degree. On leaving the University he started his aeronautical career in 1934 with the Hawker aircraft company at Kingston. He left Hawker, in 1937, to join Saunders-Roe in the Isle of Wight and he remained with that company until March of last year.

During that time, he was closely associated with the design of many notable Saro aircraft, among them the Princess flying-boat, and in 1951 he was appointed chief designer. In that capacity he was responsible for the design of the remarkable S-R 53 mixed-powerplant fighter, powered by a Spectre rocket engine and a Viper turbojet—the first prototype of which is still engaged on research flying from Boscombe Down. He was also responsible for the design and development of the very successful Black Knight re-entry test missile.

Maurice Brennan's last task before he left Saunders-Roe to seek a change of environment, was to develop the prototype SRN-1 Hovercraft for which the company had a contract from the National Research and Development Corporation. With the Hawker Siddeley Group's lively outlook and keen appreciation of potentially valuable development, it would not surprise many people if, in due time, the Group were to go into the cushion-craft business.

Producing the R.C.A.F.'s Starfighters

FROM Canadair has now come news of plans in relation to the production of 200 Lockheed F-104 strike-reconnaissance Starfighters for the R.C.A.F., for which the Canadian company is the prime contractor. In addition to Canadair's airframe contract, worth $91.5 million, Orenda Engines, Ltd., of Toronto, has an $80 million contract for the powerplants. The whole programme for the aircraft is said to total $420 million.

Much of the work involved is being sub-contracted by Canadair to a number of Canadian companies—to the tune of some $25 million. Avro Aircraft, for example, are to build $2.6 million worth of air intake scoops and ducts; Canadian Car Company, Ltd., of Fort William, has been given a $2.4 million contract for forward fuselage structures. Other sub-contracts will be placed for such items as main and nose-wheel undercarriage units and hydraulic systems and equipment; competitive tenders have already been asked for.

The first of the Canadian Starfighters—designated the CF-104—is scheduled to make its first flight in the spring of next year. All 200 are expected to be completed by the end of 1962. Canadair also has a sub-contract from Lockheed for the production of wings, rear fuselages and tail units for 66 F-104Gs being built by the American company for West Germany.

In order to facilitate rapid production of these new fighters for the R.C.A.F., Canadair has placed contracts with other Canadian companies for work on some of its other aircraft types. For example, the Winnipeg Division of Bristol Aero-Industries will manufacture engine mountings and components of the CL-44 turboprop transport. Overhaul and maintenance of North Stars is being done by Aircraft Industries of Canada at St. Johns. Tail units and ailerons for the Sabre spare-parts programme are to be made by Roy Industries at l'Assomption, Quebec, and machine shop work for various Canadair projects has been farmed out to companies in the Montreal area.

Celebrating Good Liaison

FOR the past several years it has been the custom of the company representatives resident at A. and A.E.E. Boscombe Down to hold an annual party at which they entertain the A.O.C. and Service and civil members of the Establishment and the Ministry. This year's occasion, which was on February 10 in Salisbury, was reckoned by hosts and guests alike to have been one of the most successful to date.

This is certainly a function that is going from strength to strength for this year there were rather more than 100 people present—with the guests from A. and A.E.E. and the M.o.A. outnumbered some three to one by the industry. In addition to the industry's "Boscombe residents," senior representatives from the companies concerned were at the party in force—some of them having travelled considerable distances to be present. It is interesting to record, in contrast, that the prototype party—held in 1952 at High Post—was a comparatively small affair, with only some 50 members and guests present.

Informality has always been the order of the evening on these occasions and in this respect the 1960 edition was no

OPERATIONAL DETERRENT.—Three R.A.F. Thor IRBM bases are now operational and a fourth is scheduled to come into service in the summer. Each base houses five squadrons operating a total of 15 missiles. More pictures are on page 213 and a description of the deployment of Thor in R.A.F. Bomber Command is on pages 229 and 230.

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exception. There was, however, one major change; whereas in previous years the party has taken the form of a dinner, this year it was organized as a general reception and buffet supper. By this means everybody stood a better chance of meeting everybody else and there was much greater freedom for exchange of friendly discussion.

The guests were welcomed by Mr. P. E. Pearce, of Bristol Siddeley, of the organizing committee. Among them were Air Cdre. A. E. Clouston, C.B., D.S.O., D.F.C., A.F.C., A.O.C. Boscombe Down; Dr. D. Cameron, the chief superintendent; the superintendents of the various sections; heads of departments; and the C.O.s of the Squadrons. Mr. Pearce expressed a few informal views on the effect of the recent mergers within the aircraft industry and paid a warm tribute to the staff of the Establishment.

He disclosed that Air Cdre. Clouston was planning to retire in the very near future. As he said, there is no doubt that the Air Commodore will be sadly missed; he has done much for Boscombe Down during his stay there and he will long be remembered for his tremendous and enthusiastic contribution to aviation in the 1930's. Everyone will join in wishing him well in his retirement. He was presented at this party with a small model of the de Havilland Comet (circa 1934) as a memento from the Boscombe industry representatives; the presentation was made on their behalf by Mr. E. Vousden of Fairey Aviation.

In his speech of thanks Air Cdre. Clouston was in great form and produced some telling comments about some of his hosts. In a more serious vein he spoke warmly of the close co-operation that existed between the industry, the Establishment and the Services; no fewer than 36 companies were, he said, represented at Boscombe—not all of whom had aircraft there.

Why do we Hoard our Junk?

THE recent articles and correspondence with regard to the safety of the private pilot have prompted me to put forward a point of view which has hitherto gone unmentioned.* It is a question of the suitability of the majority of aircraft and equipment that comprise the total of private clubs and business aircraft on the British Register.

In the main, our light aircraft are poorly instrumented and mostly without radio and navigational aids. The relatively slow speed of approximately 100 m.p.h. seems to be the accepted formula. Very largely due to this inadequacy of our light aircraft, the standard of flying skill and instruction is limited to the point where most private pilots do not possess the skill to fly in anything but VMC plus. Even then, the standard of flying is not sufficiently high.

Why do we hoard our junk? Perhaps to a point, it is a part of our make-up. It may even reflect our dislike of officialdom, our not wanting to be pushed into obeying apparently stupid rules, that were misinterpreted as being the Ministry trying to put the clamp on private flying. Unfortunately, these rules were very necessary and were a logical pursuit of safety in the air. Still, we prefer to fly by the "seat of our pants," or so it would seem. Of course, this is not entirely true, and some blame must inevitably fall on the Government. Why, oh why, was no official encouragement given to private aviation? We are now in the unpleasant position of being the backward boys of private aviation in the Western World.

If only the Government could have promoted, perhaps, two really first-class centres of private aviation for London and one for each large provincial city, with subsidies for club fleet purchase and fuel. If only this had been done, then we would not be in today's unhappy position. Government subsidies for private aviation have, in the past, always been suggested under the guise of providing a nucleus of pilots of intermediate standard, suitable for service in the event of War. This is obviously now absurd.

Thus, I suggest subsidies on the grounds of safety, not to mention that if British private aviation were back on its feet again our prestige would greatly improve. This may well reflect itself in the commercial side of British aviation.

If such action had been taken it would surely have enabled our only remaining light aircraft manufacturer to produce aircraft at least as good as any foreign constructor. Not having this, our only lightplane constructor has had to depend largely upon Army orders for its existence, and it does not necessarily follow that an aircraft developed from these types is entirely suitable for private purposes.

Due to lack of orders, the electronics manufacturers have not produced the cheap and efficient VHF, HF sets and navigational aids suitable to the private aviator. Thus came about the decline.

The answer to the present problem is to become equipped with better aircraft in the first place. This would certainly lead to better flying. Secondly, a revision of instrument rating standards for the private pilot. Thirdly, a Government subsidy to private pilots who intend qualifying for an instrument rating for inclusion with their licence. In this respect, it might be advisable if the Government were to nominate the school where the candidate would undertake his/her training.

On the question of suitable aircraft, there are of course, several excellent types available from various manufacturers on the Continent. But in most of these aircraft, the purchaser is usually referred back to Britain or America for radio/nav. equipment.

As is well known, America leads the World in its production of light aircraft. All the Piper, Cessna and Beech aircraft made available for sale in this country are fully instrumented, many with single axis auto-pilots, and almost all have VHF radio. Most of these radios are of a cheaper construction than those accepted as being British airline standard, though apparently they are no less efficient for this type of operation. They are designed specifically for the lightplane.

Several models of Narco, Lear sets and others are a combined VHF transceiver/nav. aid package. The receivers are capable of operation from 108-126.9 and to 135.9 M/C which takes in the ILS, VOR, broadcast and R/T range with an Omnimeter giving left/right to/from indication, as well as ILS localizer, plus a 75 M/C beacon-receiver; as if this were not enough a 2-band L/F rec. for range and broadcasts, is often thrown in for good measure.

Furthermore, costs are not prohibitive on these aircraft. A good, used Tripacer can be bought from £2,200 including duty, delivery U.K.; single-engined Cessnas from £2,600; Beech Bonanzas from £3,500. The extent to which these aircraft can be flown depends more upon the pilot's ability than the weather.

For those who prefer to buy British, there is nothing wrong with a really good Auster, though the newer the better. The quality of workmanship on Austers is as good as any foreign competitor. But there is every indication now that for sheer value a Tripacer is preferred.

But whatever we buy, we must use radio and navigational aids. VOR is simple enough for the simplest private pilot to navigate with efficiency and safety, and more Omni stations are appearing, not to mention the many Omni stations already operated here by the U.S.A.F.

What is more, VOR/Omnimeters in sets are cheaper than ADFs, less liable to malfunction, simpler, lighter, and being in the VHF range, not subject to the errors of ADF and other M/F receivers. When we have VOR coverage in the U.K. and Europe (which is coming) and the aircraft and pilots capable of using them, a generally higher standard of flying and safety will result.

Pilots using radio aids invariably and automatically put themselves in the hands of controllers and even enjoy obeying rules; this will then be the beginning of greater air safety. But, for goodness' sake, let us start now to "put our private aviation house in order" by re-equipping.

Let us not condemn light aircraft of vintage claims, or the not so well off pilot, with his Tiger or Maggie, but let's limit their flying to uncontrolled airspace and VFR flight only.

It may also be worth considering the possibility of common frequencies for tower, approach, airways, by private aircraft pilots. This would achieve two things, (a) relieve congestion from frequencies used by commercial aircraft, and (b) enable a small 4-channel set that is relatively cheap to obtain, to be used. This would enable almost every aircraft to be equipped with two-way VHF.

Turning from radio, and finally back to visual aids, to which we all resort at some time or other, the Ministry could help aviation considerably if they were officially to encourage and perhaps sponsor, farmers and factory owners, etc., to give directional indication on barns and factory roofs. These could include statements such as "RUGBY 10 MILES WEST," with True North painted indication. The Americans find this most useful in the U.S.A.

In conclusion it is only necessary to watch the enthusiastic way that owners of new Pipers, Cessnas and Beechcraft aircraft are enjoying this modern approach to private flying and take a lesson from them that will benefit all concerned with the operation of aircraft.

KEITH JOHNSTONE.

* Except in THE AEROPLANE AND ASTRONAUTICS.

The Industry—Mr. Sandys' Statement

AT Question Time in the House of Commons on February 15, the Minister of Aviation made his long-awaited statement regarding Government policy in relation to the reconstituted aircraft industry. Mr. Duncan Sandys said:—

"The Government regard it as essential that the United Kingdom should maintain a strong and efficient aircraft industry, capable not only of providing the Armed Forces with aircraft and guided weapons, but also of playing a prominent part in the World-wide development of civil aviation.

"On my appointment as Minister of Aviation, four months ago, I discussed the whole position with the aircraft industry. I expressed to it the view that the increasing cost and complexity of modern aeroplanes, together with the intensification of foreign competition, now made it necessary for manufacturers to possess much greater financial and technical resources than hitherto. For this reason, I suggested that they might consider creating stronger units by the amalgamation of suitable firms. I explained that the pattern I had in mind would consist of five major groups—two making fixed-wing airframes and guided weapons, one making helicopters, and two making aero-engines.

"I found a ready acceptance of the need for radical reorganization; and I wish to express to the industry my appreciation of the prompt manner in which it has acted. In fact, the initial process of regrouping is now virtually completed, though, naturally, much remains to be done by the new groups to consolidate and rationalize their resources.

"The sharp reduction in Government orders for military aircraft, which represents such a large part of the industry's business, has made it urgently necessary to expand sales of civil types at home and overseas; and the Government have been considering ways of helping manufacturers adjust themselves to this changed situation.

"In order to provide a sound technological foundation, the Government will for the present continue to maintain a substantial programme of aeronautical research.

"Except where specialized requirements or public policy make it necessary to do otherwise, we intend to concentrate Government orders on the five major groups. At the same time, we shall seek to harmonize the characteristics of military and civil types of transport aircraft.

"In view of the growing importance of the civil market, the Government have decided to provide increased support where appropriate, for promising civil aircraft projects and aero-engines. The nature and extent of the assistance will vary. The Government may contribute towards the development, tooling or other initial costs of launching a new type. In order to enable earlier delivery dates to be offered, the Government may also, in suitable cases, take a share in the risks involved in producing a limited number of aircraft beyond those for which firm orders have been received. Furthermore, the Government may be prepared to contribute towards the cost of proving a new type of civil aircraft and of introducing it into regular airline service.

"Suitable arrangements will be made for the Government to participate in the proceeds from sales. The manner in which these will be shared between the Government and the firm will vary and will depend, among other things, upon the proportion of the risks borne by each.

"Concentrated thus in a small number of strong units and adequately backed by the Government, I am confident that the British aircraft industry will now be better fitted to meet the needs of modern defence, and will be better able to secure its due share of the expanding market for civil aircraft throughout the World."

In answer to supplementary questions Mr. Sandys said that he had no doubt that the mergers would make a stronger aircraft industry with better prospects for sales at home and overseas and would, for that reason, improve prospects of employment. It was not the intention of the Government to back too many conflicting or competing projects; but he would not rule out, in the first stage, the possibility of support for two overlapping projects "provided that the commercial prospects justified it."

Defence Plans for 1960-61

MAIN points in the 1960 Defence White Paper, published last Tuesday, are as follows:—

"One of the aims of research and development in the field of the strategic deterrent is to devise a means of delivery that is invulnerable to the opposing defences. The development of the British ballistic missile Blue Streak is continuing. However, it may be decided not to rely exclusively on fixed-site missiles as the successor to the medium bomber armed with the stand-off powered bomb. Therefore, the possibilities of mobile launchers, whether aircraft or submarines, for long-range delivery of nuclear warheads are being investigated."

In a paragraph on research for new weapons, the Bristol 188, the Short S.C.1 and the Hawker P.1127 are all mentioned. "The Short S.C.1 research aircraft and the Hawker P.1127 are being used to investigate vertical take-off," it states—somewhat prematurely in the case of the P.1127, which is apparently regarded mainly as a research aircraft.

Mention is also made of the problem of defence against ballistic weapons and it is said that this is being examined. It is also stated that arrangements are being made with the U.S. authorities which will provide a ballistic missile warning system for this country.

The White Paper refers, as it did last year, to the improved performance of the Mk. 2 Victor and Vulcan V-bombers. "The readiness of bombers in this country will be improved and their dispersal increased, and measures will be taken to make it operationally easier to deploy them overseas."

Other news about aircraft is that considerable progress has been made with the detailed design of the T.S.R.2 intended for the strike and reconnaissance rôle; that the Lightning supersonic fighter is now being flown by R.A.F. pilots and will enter regular squadron service within the next few months; that, in addition to Whirlwind helicopters, a more advanced helicopter will be developed for the quick movement of troops within the tactical area.

The 1960-61 defence estimates total £1,630 million (to the nearest million pounds). This is £115.7 million above the 1959-60 estimates. From these figures, £12 million receipts from Western Germany are deductible. Estimates for the various departments, after deduction of German receipts, and with 1959-60 estimates in brackets, are:— Admiralty, £397.50m. (370.70); War Office, £477.45m. (431.35); Air Ministry, £527.46m. (490.80); Ministry of Aviation, £198.85m. (Ministry of Supply, £191.80m.); Ministry of Defence, £16.57m. (17.48).

Nearly half the defence budget—49% in 1960-61—is to be spent directly on Service personnel and civilians working with the Forces; these costs cover pay, allowances, retired pay, food, clothing, housing and transport. Research and development of future weapons accounts for 14% of the total budget and another 28% is to be spent on weapons, equipment and stores. The balance, 9%, covers miscellaneous expenditure which includes storage, operational works and fuel.

* * *

In the light of the White Paper's statements regarding Blue Streak and research, it is interesting to record that in answer to questions in the House on February 15, the Minister of Aviation confirmed that design studies of the modifications needed to make it possible for Blue Streak and Black Knight to be used for launching satellites, were going ahead. On the subject of expenditure on space-research—a figure of £20m. a year was suggested as necessary by one speaker—Mr. Sandys said that in the first case expenditure would be modest; but he had no doubt that as the programme developed expenditure would increase.

Controlled Freedom

THE final draft of the eagerly awaited Civil Aviation (Licensing) Bill became available as we closed for press with this issue. A detailed explanation and comment will be given in next week's issue. The Bill has four main features:—

It repeals Section 24 of the Air Corporations Act of 1949, which grants a monopoly of scheduled services to the two Corporations; the independent carriers will no longer need to operate as "associates" and will have equal right to apply for route licences.

An independent Air Transport Licensing Board will be set up by the Ministry of Aviation and this Board will issue Air Service Licences to approved operators.

An Air Operator's Certificate will also be issued by the Director of Aviation Safety, of the Ministry, to carriers whose equipment, organization and operational arrangements appear to be adequate to ensure safety.

Air ambulances, air taxi, crop-spraying and photography services and flights for which the whole aircraft is chartered by one person will be exempted from the need to have an Air Service Licence. But this *will* be required for flights on which accommodation is "sub-let" to passengers paying separate fares.

IRBMs for the R.A.F.

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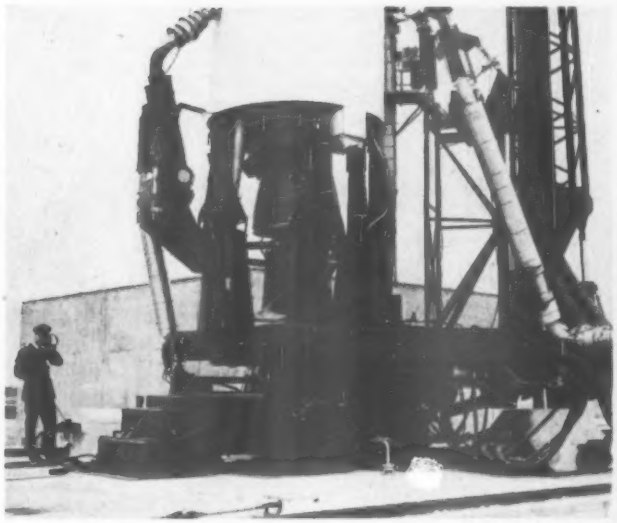
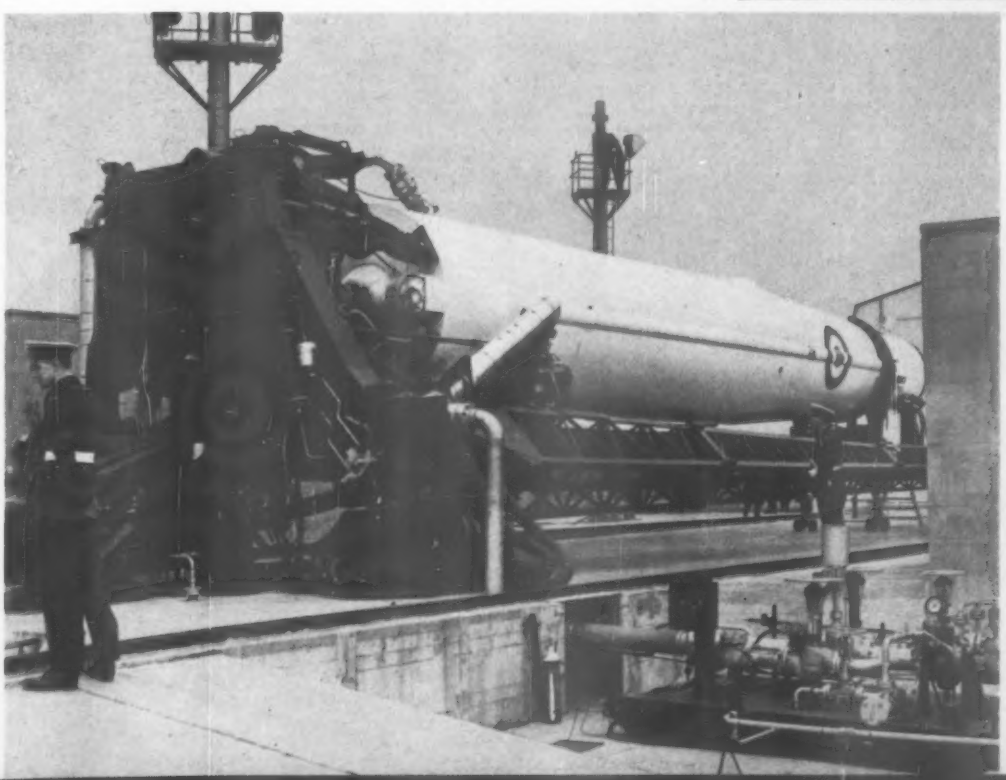


Last week, the R.A.F. released more information about its Thor IRBMs which are now operational at Feltwell and elsewhere. Details are to be found on pages 229 and 230. On this page are views of the missiles at one of the launching sites.

Above left, a close-up of the launching pad and the base of the missile in firing position, as above.



Thor on the launcher prior to being raised in readiness for firing. The missile has a range of some 1,500 nautical miles; the R.A.F. bases are now manned on a 24 hr. basis.

Aviation News in General

U.K. ROCKET DISCUSSION.—We are informed that the joint meeting of the Royal Society and the Royal Meteorological Society on "The British Rocket Programme," as announced in our issue of February 5, will be held at the Royal Society of Arts on March 4.

LOST AND FOUND?—The U.S. Defense Department announced on February 10 that an unidentified object "which may be of Soviet origin was orbiting the Earth over the North and South Poles." It was described as slightly smaller than the U.S. Discoverer satellite. Two days later, the Secretary of the U.S. Air Force said that the "mystery satellite" was, in fact, probably a Discoverer.

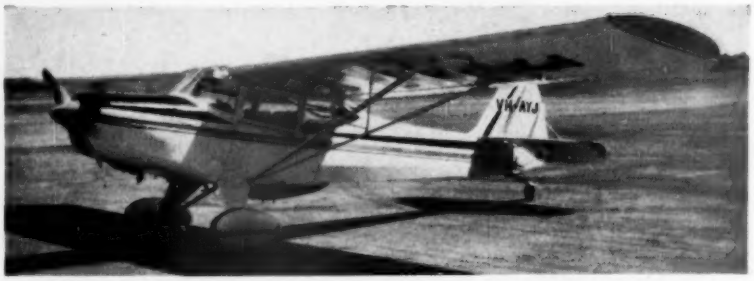
MISSILES ON RAILS.—The U.S. Air Force is to use railway trains armed with 6,300-mile range Minuteman ICBMs "to roam the country ready to retaliate against any possible attack" by 1963. A missile train would carry two or more missiles; special carriages would carry the missile commander and firing crew.

"ANTI" STRIKE.—On January 29 at White Sands, New Mexico, an Honest John artillery rocket was successfully destroyed in the air by a Hawk "low-altitude" surface-to-air missile.

HIGH CLIMB.—The North American X-15 made a third successful powered flight on February 11. Released from a B-52 at 45,000 ft., it climbed to 80,000 ft., the highest yet, and reached a speed of over 1,400 m.p.h.

MOSCOW LINK.—A 9-mile overhead railway has been proposed to link Vnukovo Airport with the Moscow underground system. The track will be about 20 ft. high, on which 75-seat coaches will travel at speeds of up to 100 m.p.h.

REGISTERED.—Among the latest additions to the British Civil Register is a Knight Twister (G-APXZ), which Mr. Chris de Vere plans to build. One of the Saro-built Hiller Rotorcycles has been registered G-APYF for demonstrations by Helicopter Sales, Ltd., and T. D. Keegan is shown as the owner of Catalina G-APZA. The two Comet 4Bs for Olympic Airways have been registered G-APYC and G-APYD in the name of B.E.A., which is handling the contractural details. Several new Piper Tri-Pacers and Comanches are registered together with a Cessna 175.



KINGSMITH.—Following last week's report of a new range of Lycoming-powered Austers comes this photograph of an Autocrat so modified in Australia by Kingsford Smith Aviation. Called the Kingsmith, it has a 150-b.h.p. Lycoming, soundproofing and spats.

SUPER CONVAIR FLIES.—First flight of the Allison 501D turboprop conversion of the Convair 440 has been made at Santa Monica. Gross weight has been increased to 53,200 lb. and outer-wing fuel tanks added to give a range of more than 2,000 st. miles. Maximum payload range is 675 st. miles and max. cruising speed is 345 m.p.h. Lake Central Airlines has ordered five Super Convair conversions.

NORSEMAN NEWS.—Production of the Noorduyn Norseman has ended at Cartierville (Montreal) almost exactly 25 years after the first of these rugged Canadian bush aircraft was flown. In all 918 Norsemans were built, including more than 800 during the war years, mostly for the U.S.A.A.F. Many hundreds are still flying. An all-metal development of the Norseman design is expected to start its flight trials soon in Dallas, Texas.

PAKISTAN SURVEYS.—Contracts have been placed with Hunting Surveys, Ltd., for aerial photographic cover of Chittagong and Khulna to help in the planning of modernization schemes for these two East Pakistan towns.

BETTER AG-CATS.—Grumman Ag-Cat dusters and sprayers are now available with 300-b.h.p. Lycoming or 450-b.h.p. Pratt & Whitney engines, in addition to the original 220-b.h.p. Continental installation. The new engines make it possible for the Ag-Cat to carry special chemical dispensing equipment and to operate better at higher altitudes. The Ag-Cat is produced for Grumman by Schweizer Aircraft Corp. at Elmira, New York.

GERMAN G.91s.—The number of Fiat G.91 fighter bombers to be built under licence in Germany has been increased by the Bundeswehr from 150 to 232. An additional 50 aircraft will be imported from Italy.

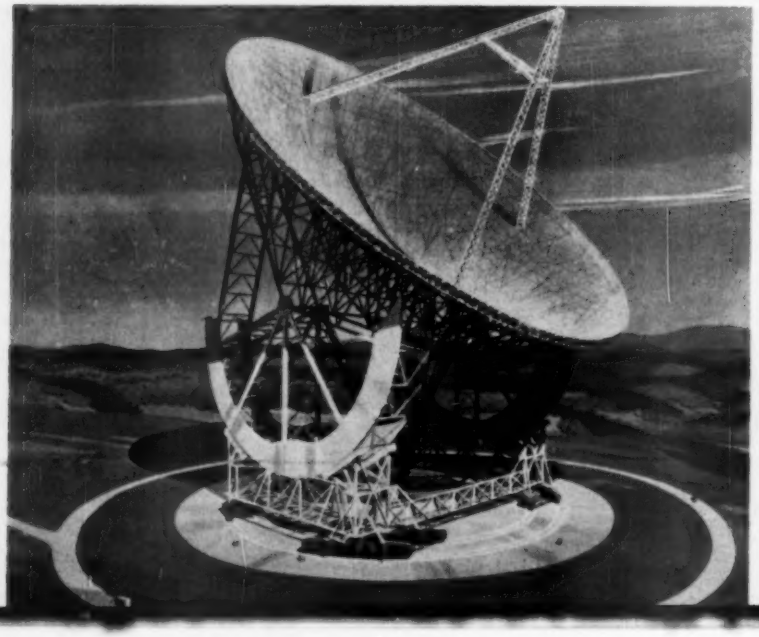
COMET NIGHT TRIALS.—The M.o.A. is to conduct further noise tests on the Comet 4B at London Airport before reaching a decision on B.E.A.'s request to operate "a few" scheduled Comet services at night, including the twice-weekly "Midnight to Moscow."

FAST DELIVERY.—On its delivery flight, the fourth of K.L.M.'s Electras flew from New York to Amsterdam non-stop in 8 hr. 16 min. at an average speed of 483 m.p.h. All the delivery flights to date have been made by Captain Frank Hawkins, a senior K.L.M. pilot.

NAPIER SIERRACOTE.—D. Napier and Son, Ltd., has recently concluded an agreement with Sierracin Corporation of Burbank for the production of Sierracote and Sierraglo processes in the U.K. Sierracote will complement the Napier Spraymat de-icing system, as a transparent conductive coating for heating windscreens and cockpit canopies for de-icing or de-misting purposes.

A.R.B. NOTICE.—The A.R.B. has issued Notice No. 15 Issue 2 to Licensed Aircraft Engineers and Owners of Civil Aircraft. It concerns the locking of A.G.S. and similar type pipe couplings.

LECTURE POSTPONED.—The R.Ae.S. Man-powered Aircraft Group lecture on "Natural Flight," by Peter Scott, has been postponed from February 24 to a later date.



Artist's impression of the new 600-ft. diameter radio-telescope under construction at Sugar Grove, Virginia, which will dwarf Jodrell Bank. See also page 232.

Commercial Aviation Affairs

VISCOUNT 416.—Vickers have now confirmed the Austrian Airlines order for six Viscount 837s. Four will be delivered by the end of March, one in June and one in July. The total of Viscounts sold is now 416, including one V.810 Executive sold recently to an unspecified customer.

VERTOL ORDER.—As reported in our summary last week of a paper by Mr. Robert L. Cummings, president of New York Airways, this helicopter operator has decided to purchase 10 Vertol 107-IIs. Five will be delivered in the spring of 1961 and the other five before the end of 1963.

AUTOMATIC A.T.C.—A start with the introduction of automatic data processing for air traffic control is to be made next year at Scottish A.T.C. Centre at Redbrae. In the spring of 1961 the first computer for the purpose, from Ferranti, is to be installed by the Ministry of Aviation to aid in the work of control and separation of North Atlantic traffic in the area. The Scottish centre is due to be transferred, in March, 1963, to the R.A.F. radar site at Gailes which has already been taken over by the Ministry.

IRISH PLANS.—Irish Air Lines plans to have its Boeing 720s in service across the Atlantic before Christmas. The first delivery is scheduled for November. During the year, three new routes are to be inaugurated: Dublin-Leeds on April 2; Shannon-London on May 30 and Dublin-Cherbourg on June 1. The company has recently exchanged two of its Viscount 707s for an Eagle Airways Viscount 805, bringing its Viscount fleet to seven. The Viscount 707s are being used by the Eagle (Bahamas) company, and two other ex-Aer Lingus 707s have been purchased by Tradair, the independent operator at Southend.

AIR AND SEA TRAFFIC.—In the first nine months of 1959, there was a 12% increase in the number of passengers travelling to and from the U.K. by air. Sea traffic increased by 5% in the same period, mostly on Continental routes. Totals were 6,284,000 by sea and 4,385,000 by air, according to the Board of Trade.

K.L.M. STILL BARRED.—A Dutch delegation in Washington has once again failed to obtain from the U.S. Government permission for K.L.M. to operate to the U.S. West Coast. The American attitude was described as "unjust and grievous" in the Dutch Parliament and was recently condemned by Prince Bernhard.

707-420 CERTIFICATION. — The Federal Aviation Agency certification of the Conway-engined Boeing 707-420 series, announced last week-end, involves the following maximum weights: taxi-ing, 312,000 lb.; take-off, 311,000 lb.; and landing, 207,000 lb. The -420 has been ordered by Air India International, Lufthansa, Varig and B.O.A.C. The aircraft for B.O.A.C. await A.R.B. certification, for which, as explained in our issue of February 5 (p. 150), certain modifications are required.

DC-8s FOR T.C.A. — A Conway-engined DC-8 has been delivered to T.C.A., ahead of certification, for crew familiarization. Seating 99 economy-class and 28 de luxe-class passengers, the T.C.A. DC-8 will go into domestic service on April 1, and on the Montreal-London route on June 1.

T.C.A. INAUGURAL.—T.C.A. will inaugurate a Halifax-London service on April 2, using Super-G Constellations.

CV 880S FOR J.A.L.?—After investigating the Comet 4C, Caravelle VI, Boeing 720 and Boeing 720B, Japan Air Lines has turned its attention to the Convair 880M as possible new equipment for its routes in south-east Asia and through India to Europe. If the Convair 880 is chosen, three will be ordered, for delivery within 16 months.

ANOTHER CARAVELLE.—S.A.S. has increased its Caravelle order to a total of 18 (including four for Swissair), and has taken an additional option, to be exercised in 1961.

MUNICH DECISION.—Officials of the West German Federal Aviation Office said last week that there was no justification for re-opening the investigation of the crash of a B.E.A. Elizabethan at Munich. The cause of the accident was "ice on the wings and nothing else. . . . There is absolutely no truth in the reports that it was slush on the runway or the inadequacy of the runway," said Werner Treibel, secretary of the German Airport's Association.

News About People

MASCO APPOINTMENT.—Wg. Cdr. W. W. Warner has accepted the appointment of consulting engineer to the Mideast Aircraft Service Company in Beirut, where he will be stationed for about six months in an advisory capacity. "Bill" Warner has an unusually long and wide experience of aircraft and airline engineering. Since leaving Airwork, with whom he was chief engineer of its now-disbanded air transport division, his services have been available as a consultant. MASCO, a B.O.A.C. associated company, is an aircraft engineering and overhaul organization serving operators in the Middle East.

G.P.S. APPOINTMENTS.—Mr. C. Evans and Mr. P. C. Haines have joined the staff of the Air Traffic Management division of General Precision Systems, Ltd., at Bilton House, 54/58 Uxbridge Road, Ealing, W.5 (Telephone EALing 1845/6). Mr. Evans was formerly B.O.A.C. Fleet Navigation Officer, Britannias; and Mr. Haines was with the Ministry of Aviation.

APPRENTICE SUCCESSES. — Prize winners among Handley Page undergraduate and engineering apprentices for the 1958-59 session were D. Isaaks (Fifth Year); P. Chappell and R. Godson (Fourth Year); R. Minchin and A. King (Third Year); R. Charlesworth and M. Pope (Second Year); and J. Smith and P. Sladden (First Year). Trade apprentices gaining prizes were G. A'Bear; R. Burne; T. Gurd; H. Smith and M. Davy. Apprenticeship diplomas go to D. Black; K. Cugnoni, D. Short, W. Blakeley, B. Brasier, R. Burrin, R. Free, E. Hiller, D. Isaaks, R. Pointer, N. Ritchie, C. Roderick, D. Sherriff, A. Smith and R. Taylor.

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POWERPLANT TEAM.—Four members of the Bristol Siddeley team at Filton who are closely concerned with future projects. Left to right: E. L. Newport, development fitting shop manager; J. D. Shearing, of the project department; F. Marchant, assistant chief engineer, design; and N. Quinn, assistant chief engineer, performance. The Bristol Jubilee story begins on page 220.

PAUL CODOS.—The French flying pioneer, Paul Codos, died in Paris on February 2 at the age of 63. During his flying career he held the long-distance air record with another Frenchman, Maurice Rossi, and a round-the-World record. They accomplished the sixth successful east to west crossing of the Atlantic in May, 1934.

P.I.A. CHANGE.—Mr. R. H. Kazmi, district manager, U.K., for Pakistan International Airlines, has returned to Karachi to take up an appointment in the commercial department. He is succeeded by Mr. M. K. Janjua, who has recently retired from the Pakistan Air Force.

BOARD APPOINTMENT. — BTR Industries, Ltd., have announced that Sir Walter Worboys has been elected to the board and appointed a deputy chairman.

Air Transport

Rationalizing MATS Operations?

ACCORDING to reports from Washington last week the President has approved a Pentagon decision to transfer a proportion of the U.S.A.F. Military Air Transport Service traffic to the civil operators. The decision may mean a doubling-up of the military transport business at present being passed on to civil U.S. carriers. The overall recommendation submitted by the Secretary of Defence is that MATS should withdraw from routine transport operations and a programme to this effect is to be completed by May 1.

Among the courses of action in the programme is one to the effect that suitable arrangements should be made for Government participation in the cost of developing long-range turbine-powered all-cargo aircraft. This means that Douglas, Boeing and Convair may be able to go ahead with the production of freight versions of their turbojet transports and that the Lockheed GL-207 civil development of the C-130 may become available. So far the GL-207 has been offered to civil operators subject to U.S.A.F. support and the turbojet cargo variants, including the Boeing 735 (civil) and 738 (military) swing-tail freighters, have awaited adequate orders. Douglas has a swing-tail, turbofan-engined DC-8 development on the stocks and Convair similarly has proposed a swing-tail Model 600.

The programme appears to overlap Senator Monroney's long-delayed bill in which (see the issue of January 15, p. 63) 10-year loans might be guaranteed by the C.A.B. for the purchase by operators of approved all-cargo aircraft following the transfer of much of MATS present work to the civil carriers.

Douglas Backs the Caravelle

THE likely pattern of short-haul turbojet transport development changed abruptly last week with the announcement that the Douglas Aircraft Company had entered into an agreement with Sud Aviation for the licence production of the Caravelle in the U.S.A. Whilst not entirely unexpected (see our issue for January 22), this news will be widely regarded as a blow to British hopes of selling the Airco D.H.121 and even the Vickers VC11 in America. Backed by the technical and commercial resources—and the name—of the World's foremost manufacturer of civil transport aeroplanes, the Caravelle now has a much better chance of satisfying the U.S. market for a short-haul turbojet.

A joint statement by Douglas and Sud Aviation says that the agreement between the two companies gives Douglas the right to build the Caravelle, and to act as selling agent for it throughout almost the whole World; Sud Aviation will remain responsible only in Continental Europe (not Britain) and in French-speaking areas. Douglas will collaborate in the development of future versions of the Caravelle and will establish and run spares stores in New York and on the West Coast. Douglas and Sud Aviation employees will be exchanged for technical training, and close collaboration is to be maintained between the two companies on all their aviation projects—including the DC-8.

Production of the Caravelle will begin (presumably at Santa Monica) when sufficient orders (50-75) are in hand. The first will be placed shortly by United Air Lines, which has played a key rôle in bringing about this highly significant Franco-American agreement. It was to satisfy United's requirements, among others, that Douglas designed the DC-9, but this found no takers, either in its four-jet "baby-DC-8" form or in a later three-rear-engined version. Instead, United took a long, close look at the Caravelle—and liked what it saw.

The Douglas decision to drop the DC-9 in favour of the Caravelle obviously has much to recommend it, especially as it means earlier deliveries and lower development costs. The arrangement has been concluded in the face of attempts by Convair to obtain a Caravelle licence. The United order will be for 20 Caravelles at more than £1 million each, with an option on 20 more. Douglas deliveries are promised in less than two years from the start of production.

Up to the time of the Douglas announcement, 62 Caravelles had been ordered—61 by airlines (mostly European) and the odd one by General Electric for a trial installation of the 16,000-lb.s.t. CJ805-23 turbofans. This is the engine which is expected to be standardized in the Douglas-built version, in place of the Rolls-Royce RB141 which Sud Aviation originally specified for the Caravelle VII.

The Caravelle, in its present and future versions, carries a maximum payload of 18,500-19,500 lb. and has a range of 1,100-1,300 naut. miles (with reserves for 1 hr. holding and 150 naut. mile diversion) with full payload. Cruising speeds are of the order of 420-430 knots at typical weights.

The Air-freight Business

THOSE on the outside, whose knowledge of likely future air-freight rates has been gleaned from detailed studies like those of Prof. Brewer, tend sometimes to overlook the enormous disparity in operating conditions throughout the World. For instance, they may be misled into assuming that a mathematical "average" World rate has some objective reality, whereas this average figure will have been unduly influenced by the relatively low domestic rates in the U.S.A., where, obviously, there are no Customs and import licence complications.

In fact, though the U.S. domestic rates may average around 20 cents per ton-mile, the individual variations are so enormous that the top rates are very nearly as high as the basic rates in Europe—and a good deal higher than many of the European commodity rates. Nevertheless, because of the special circumstances of domestic operations in an area as large as that of the U.S.A., the average rates are probably 60% below those in Europe and allowances must be made for this fact when considering possible target rates for the future.

This year's North Atlantic commodity rates may seem to be high to the shippers—but they are ridiculously low by standards other than those set by the U.S. domestic carriers. As a means of filling the empty bellies of the big turbojets they are good business—but the scheduled all-freight operator is likely to find less than marginal profits in them and will presumably hope to keep in business by carrying loads which are not on these special commodity lists.

A little sum will show something of the divergence between these special North Atlantic rates and those typical of Europe. A particular commodity may be flown from New York to

(*Continued on page 217*)

ORDERED.—New York Airways has ordered a fleet of 25-passenger Vertol 107-II helicopters, powered by General Electric T58 gas turbines. For delivery early in 1961, the Vertol 107 will make subsidy-free operations possible by 1966, according to N.Y.A. studies. This picture shows the Lycoming-powered Vertol 107 prototype as it would appear in airline service.

Only the VANGUARD has this future while making money right from the start

THE VICKERS VANGUARD is designed for growing traffic, yet it will make profits right from its introduction with payloads no bigger than those carried by Viscounts today.

This is clearly shown in the illustration. Profit begins with the first 500-mile trip carrying no more than 42 passengers and 640 lb of freight. Even on modest estimates of traffic and freight increases, its profits will grow considerably with the years.

Assuming a 10% increase per annum in traffic, and 7% in freight, annual and cumulative profit at the end of seven years is remarkably high. By employing the Vanguard's cheap-fare possibilities, payloads and profits could be much higher.

YEAR	PASSENGERS	FREIGHT	MAIL	TRIP PROFIT
1958	42	640 lb.	250 lb.	$ 120
1960	50	735 lb.	250 lb.	$ 490
1962	61	840 lb.	250 lb.	$ 930
1964	74	960 lb.	250 lb.	$ 1,450
1966	90	1,100 lb.	250 lb.	$ 2,100
1968	103	1,260 lb.	250 lb.	$ 2,870

This diagram shows trip profit on a 500-mile sector at realistic European costs and current tourist fares. The start-point is 42 passengers and 640 lb of freight in 1958

Of all the airliners only the Vanguard has all these features

425 m.p.h. cruising • Freight capacity 7/8 tons at normal densities • Full routeing and A.T.C. flexibility • Can use normal existing airfields • Quick turn-round • No airfield noise problems • Ten years' unique Vickers/Rolls-Royce turbo-prop experience . . . ***And it is 'Viscount' quiet.***

VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE TURBO-PROP ENGINES

• ***The airliner with the biggest profit potential ever offered to the operator***

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

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For travel INSIDE the U.K., choose BEA

BEA

As a businessman you can appreciate both the complexity of the task and the value of the achievement. So, when you fly in Britain—FLY BEA.

Among the many services which BEA provides are regular scheduled air services within the United Kingdom. Today such services are an essential part of the nation's transport system. Commercial life needs them for the quick, effective conduct of business. They are indispensable, too, to millions of private travellers who have a right to the best and speediest transport available. And they are a social necessity for those who live in the remoter parts of this country — the Highlands of Scotland, the Western Isles and the Scilly Isles. It is BEA's policy to see that these air services are provided.

From the map on the left you can see how BEA's internal services have created a network over the whole country, linking all parts of the United Kingdom, making each easily and speedily accessible to the rest, providing essential services for all who need them. These are the veins through which much of the social and commercial life of the nation now flows.

And these internal services are efficient. That BEA has built up and now operates its national network without a subsidy — and at prices the average traveller can afford—is proof enough of that. Today it is a great deal cheaper than people realise to fly BEA within Britain.

THE PUBLIC APPROVES In 1949/50 BEA carried 407,137 passengers on its internal services. Ten years later the figure was 1,190,814. The reason for this increase? BEA's policy of expansion, and cheaper fares, which have enabled many thousands of people to become regular users of the BEA network within Britain.

BEA MEET THE DEMAND In 1949/50 the number of BEA flights within this country was 44,486. Ten years later the figure was 63,539. The increase in demand has been met by an increase in frequency of service. This has been achieved by the use of better and faster aircraft, and by the careful integration of internal and international services.

Four points to remember when you fly BEA in Britain

- ✳ It is BEA's policy to provide services on uneconomic routes as well as those which pay.
- ✳ BEA now provides quick, efficient travel not only for business people, but for thousands of private citizens as well.
- ✳ Some of BEA's internal services operate at a loss, yet are financed entirely from BEA's own resources, without a subsidy.
- ✳ With the development of new aircraft types including helicopters, BEA's internal services will expand to provide an even better service in Britain as in Europe.

The airline that's made big business of air travel in Europe

UNITED CHOICE.—United Air Lines, whose need for a short-haul jet was a major factor in the Douglas decision to acquire a licence for Caravelle production, has already ordered 40 DC-8s and 18 Boeing 720s. The first 720 in United markings is shown in this picture.

Air Transport . . . .

(*Continued from page 216*)

London at 6s. 4d. per kg., but the same load, flown only from London to Milan, costs 2s. per kg. For the Atlantic the European rate would thus be something over 11s., whereas the Atlantic rate applied to Europe could be as little as 1s. 2d. per kg. In other terms, a North Atlantic commodity rate might be equivalent to less than 25 cents per ton-mile, whereas the European rate for the same special commodity might be 35 cents or more per ton-mile—and the basic freight rate in Europe, even on fairly long hauls, is more like 55 cents per ton-mile.

Meanwhile, talk of bringing down the freight rates from X to Y does not really make very much sense when the present-day World rates, according to distance, environment and type of load, seem to vary between rates which differ by a factor of about five, say, from 12 to 60 cents per ton-mile.

Business efficiency experts who are also interested in the science of human behaviour might find it amusing to try to guess at losses caused by outmoded ways of thinking as demonstrated by the use of outmoded expressions. The air freight and charter business is mildly cluttered with etymological curiosities from a shipping environment. Brokers talk about aircraft "positioning in ballast"—i.e. flying empty to a load-pick-up point—and Customs people talk about "coastwise" traffic—i.e. (presumably) domestic operations. Prospects of more rapid progress are not improved, either, by the fact that the Customs and Excise staff tend to live in a world of their own and may be dealing with ships' cargo one week and air cargo the next.

Allegheny Eland-Convair Results

FIGURES are now available for the first three months of operation of the Eland-Convair 440 by Allegheny Airlines (see our issue for December 4, 1959). In July, August and September, this Convair produced an available ton-miles cost of 12.59 cents, compared with a local service airline average of 21.14 cents for all types of aircraft. With 44 seats in this particular aircraft, the cost per available seat mile came out at 1.646 cents, compared with the average of 2.05 cents, and this figure is estimated to come down to 1.392 cents using the 52-seaters which Allegheny has now ordered.

The Eland-Convair achieved a daily utilization of over six hours, compared with 5½ hours for the piston-engined Convairs. With a cruising speed of 232 m.p.h., it produced 1,338 available ton-miles per hour compared with 751 ton-miles per hour from the piston-engined Convairs cruising at an average 182.8 m.p.h.

Allegheny has now purchased this particular aircraft from Napier, and has signed the contract with Napier for the conversion of four more. These will be from the fleet of 11 Convairs purchased by Allegheny from Lockheed, the remainder being kept in reserve for possible future conversion. The original Napier conversion of a Convair 340 has also been leased by Allegheny for immediate service and was recently delivered to Washington.

Napier Inc., as already reported, has purchased nine Convair 340s from United Airlines for conversion to Eland power. These will provide a reserve from which the company can offer immediate conversion and delivery.

Transport Data Handbook

INTENDED primarily to be of use to airport authorities, the I.A.L. Handbook of Aircraft Data (1959-1960) has been published by International Aeradio, Ltd. It includes data on aircraft used for civil transport, aerial work and business purposes, and—because they frequently use civil airports—military transport aircraft are also listed.

Parameters chosen by the editor and compiler, Mr. G. R. Stroud, are those likely to be of most use to airport authorities for planning purposes and to calculate landing and parking fees. Information is given on the type and arrangement of the undercarriage, type of fuel used and the minimum turning radius, in addition to the more usual dimensions, take-off and landing weights and brief performance details.

The selection of aircraft is comprehensive, with 185 entries including variants, but the exclusion of types not expected in service before the end of 1960—such as the VC10, D.H.121, Convair 600 and turbofan versions of the Boeing 707 and DC-8—lessens the value of the handbook for those concerned with airport planning for the future. Information on maximum individual wheel loading might also have been welcomed by airport authorities.

The information appears to be reliable, but is not completely up to date—in many cases, for instance, it pre-dates that given in THE AEROPLANE AND ASTRONAUTICS Commercial Aircraft Number of October, 1959. The list of International Aircraft Registration Marks also requires some attention to bring it up to date.

The I.A.L. Handbook of Aircraft Data, which is not illustrated, costs 10s. 6d. (plus 7d. postage) from International Aeradio, Ltd., 40 Park Street, London, W.1.

The Fighting Services

The Tasks of Transport Command

MUCH of interest about R.A.F. Transport Command was put forward in the Brancker Memorial Lecture which Air Marshal Sir Denis H. F. Barnett, K.C.B., C.B.E., D.F.C., delivered before the Institute of Transport in London on February 8. Extracts from the lecture follow.

The way in which the Royal Air Force has seen fit to lay out its operational squadrons is to locate them within four operational Commands at home and, in a duly balanced proportion, within four operational theatres overseas.

There is a constitutional distinction between the layouts at home and abroad. The four theatres abroad—in the Far East, the Middle East, the Arabian Peninsula and Germany—are each what might be called a microcosm of the Royal Air Force as a whole, in that each contains a mixed complement of installations and squadrons to discharge whatever diversity of operational function may be thought to be permanently necessary within each theatre.

At home, by contrast, the operational Commands are what the official phraseologist would call functional. In fact he would probably go further and say that they are mono-functional but omni-geographical. What he would mean—and he would be right if he meant this and if his wording were intelligible to his hearers—is that each has a self-evident operational title and each is the primary executor of the function which that operational title denotes. Each runs the operational training machine to provide aircrew for that function world-wide, and each is one part of the collective home-based inter-Service reservoir whence reinforcements must stand ready to flow wherever in the World they may be needed.

One primary task of Transport Command is to move the Royal Air Force. In parallel with this, because every operation today is to a greater or less extent always a joint operation, the task is one of conferring this air mobility, which may be strategic or tactical in its nature, upon the Defence Services as a whole.

The strategic air mobility task is essentially one of movement between theatres, not within theatres. The pattern of its extent and complexity and thus the pattern also of the transport fleet required for its discharge is set, not at all unexpectedly, by what the Defence Services feel impelled to move in which eventuality and where.

Broadly, in terms of the range and speed required of the strategic transport fleet, the governing factor is the requirement to support the movement of the national deterrent force which demands a performance matching as nearly as possible that of the V Bomber force.

In terms of numbers of aircraft required in the fleet, the pattern is governed by the need, in certain emergencies, to move large fractions of the Army Strategic Reserve in formed units with specified vehicles and equipment in a single or closely coupled lifts at short notice.

A Wide Range of Requirements

In terms of load-carrying characteristics which need representation within the strategic fleet, the bracket of requirement is a wide one. At one end of the scale is the need for as liberal a capability for the carriage of a mixed passenger and freight load as is compatible with the overriding need for really high performance—not only in range but in speed. At the other end of the scale is the need for a long-range carrier of heavy and bulky loads, with a cargo hold and loading doors large enough to accept the bulkiest necessary items in the weapon inventory.

Because the need for really high performance in at least a part of the strategic fleet is a genuinely overriding need, and because this high performance will need within itself a liberal potential for development in order to be able to remain contemporary with progressive increases elsewhere, there are formidable difficulties in equating within a single aircraft the twin characteristics of high peformance and bulk.

An associated, continuous task pattern has to do with the routine transit of freight and passengers between the home base and the overseas theatres and passengers between the staging posts along the routes which extend right round the globe.

One separate activity comprises the operations of Ferry Wing. This delivers aircraft of all types to all destinations and has been so delivering, over the past few years, at a rate of some 2,000 aircraft a year.

The essence of the tactical transport task is that it relates to active operations within theatres and thus to air movement within theatres. It does not relate to movement between theatres except during the process of reinforcement. The tactical transport fleet must possess conspicuously diversified attributes to be able to discharge the multiplicity of medium range and short range transport rôles demanded by joint land/air operations in an active theatre. The tactical fleet must be globally distributed and not solely home based.

To back the theatre tactical transport forces there must exist also a home-based tactical transport element within Transport Command to do two main things. First, to train itself and its complement, the Army Strategic Reserve, in all aspects of air transported operating techniques, including that most specialized and sophisticated operation of all—the parachuted airborne assault. In aggregate, the Command launches some 50,000 parachute drops a year.

Because the basic parachute training task is, though it is not widely realized to be so, a task of Transport Command and because we use for it not only aircraft but balloons as well, it so happens that we now find ourselves to be the sole remaining guardian and repository within the Royal Air Force of ballooning techniques today.

The second main responsibility of the home-based element is to provide the reservoir for reinforcement of theatre transport forces to match the stepped-up scale of demand which arises when the theatre garrisons are themselves reinforced in an operational emergency.

The span of diverse activity which thus arises in the tactical transport way of life is prodigiously wide.

The tactical fleet will require at least two main categories of aircraft. The first family will comprise medium-range trooper/freighter aircraft. This family will have to be able to operate from sub-standard surfaces, to carry bulky loads, to launch parachutists and to drop heavy loads of supplies by parachute.

The second family will comprise short-range aircraft for employment in the forward areas. A proportion at least of these will require a capability for vertical take-off and landing (VTOL). The remainder will require a pronounced capability for short take-off and landing (STOL).

The Transport Fleet

In chronologically first place today, and in a proud and honourable position because of its achievement, stands the Hastings. For many years now, because of gaps in the inventory, it has had to double up in every rôle. It has been the long-range freighter, the trooper, the V.I.P. carrier, the parachute launcher and the strategic and tactical maid-of-all-work. It has been the backbone of the fleet and it will endure beyond the initial stage of introduction of the A.W.660.

Next comes the Beverley. Another staunch and valuable instrument with a cargo hold which enables it to perform tasks which nothing else we have can tackle. Once again, because of gaps in the inventory, the Beverley, like the Hastings, has perforce been called upon to undertake duties for which it was not intended. It is a tactical heavy freighter and parachuter—not a long-range heavy freighter. For that we must await the outcome of the announced decision to order the Britannic.

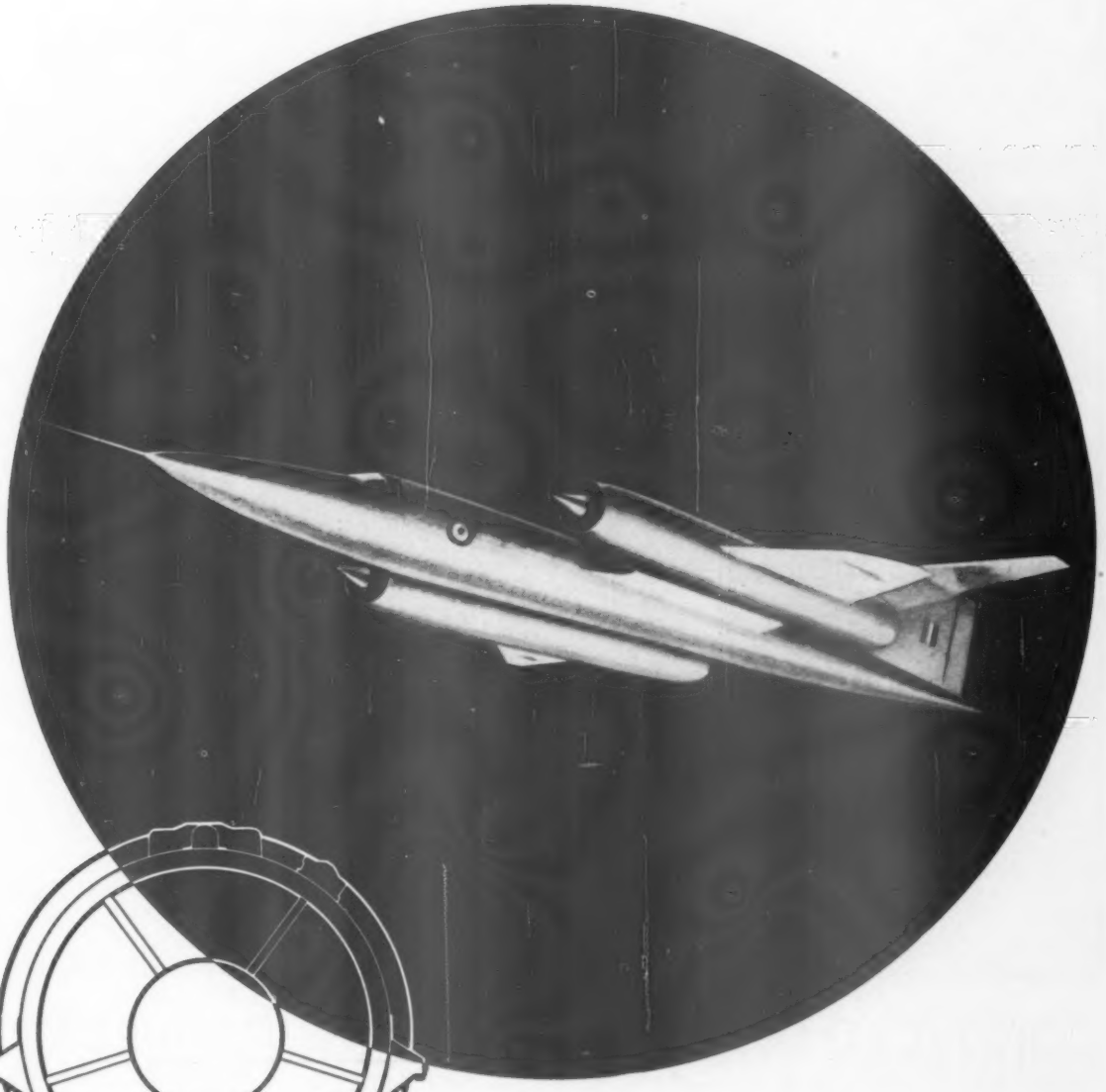
Until the start of the Britannia delivery, the Comet 2 reigned alone as the sole modern acquisition in the fleet. Although no more than of medium range it has demonstrated beyond question the startling operational value of modern high performance. Time and again, and particularly during the troubled summer of 1958, its ability to fly twice as fast and twice as high as the rest has yielded that added degree of operational flexibility in the fleet which has proved crucial. In the minds of all those knowledgeably connected with the conduct of that summer's operations in the Middle East there is no doubt that our possession of the small Comet fleet saved the day.

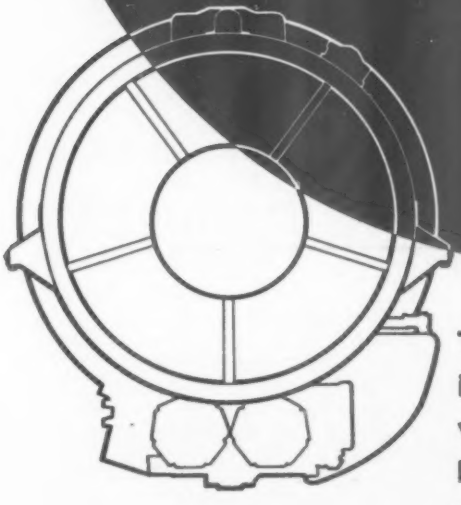
To redress the current shortcomings of the fleet in range, and to satisfy in part our need for speed and load, the Britannia force is now building. When built, its effect, measured by way of example in terms of the time required for delivery of a typical element of reinforcement to the Far East, will be to halve that time.

An important side effect also of the Britannia fleet, and later of the Britannic increment to it, will be to quench at last the need to misemploy the Hastings and the Beverley in rôles for which they are unsuitable. These two will revert to what they do best, namely tactical transport at medium ranges.

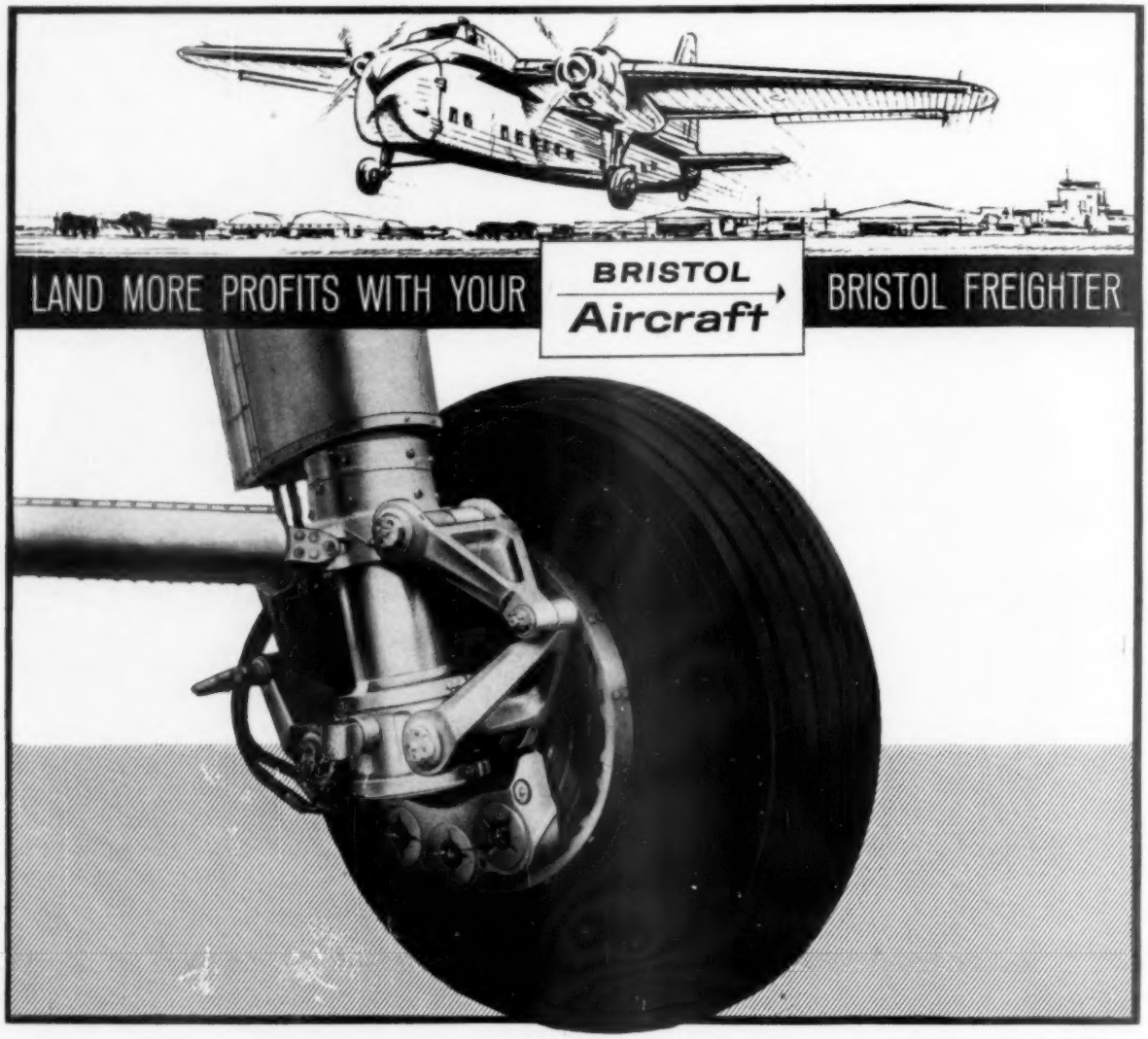
In the short-range bracket of tactical transport the essence

(Continued on page 219





The de Havilland Engine Company is pleased to be associated with Bristol Aircraft in the high supersonic flight research programme



GOODYEAR WHEEL AND BRAKE CONVERSION

Following the world-wide acceptance of the Douglas D.C.3 and D.C.4 brake conversions, Goodyear has introduced a Single Disc Wheel and Brake conversion unit adaptable to any Bristol Freighter. Its high efficiency and reduced maintenance time make possible quicker turnround with reduced operating costs per trip. The conversion has already been performance-proved on aircraft operated by Silver City Airways Ltd. from Ferryfield and Channel Air Bridge (Aviation Traders) Ltd. from Southend. These two Companies have had this profit-building conversion applied to 23 aircraft. The Bristol Freighters operating from Ferryfield make *three landings per hour* — probably the highest frequency of wheel and brake usage for Airline operation in the world.

- Low maintenance and replacement costs
- High efficiency—quicker turnround
- Increased wheel life—7,500 landings before crack detection is needed
- Pneumatically-operated emergency air system incorporated to latest ARB requirements
- Designed for simple maintenance in the field
- Manufacturer's overhaul facilities available

GOODYEAR AVIATION DIVISION

SERVING AVIATION THE WORLD OVER

The Fighting Services . . . .

(*Continued from page 218*)

of a prudent distribution of these is that, because of their short range, they should be predisposed in the theatres where they will operate. And that indeed is just where they are today; in theatre elements of Twin Pioneers and single-rotor helicopters, with the twin-rotor Bristol 192 in the offing to follow.

Until mid-December last, these overseas elements were only indirectly represented in Transport Command by one short-range squadron of single-engined Pioneers. During the intervening few weeks since then, in parallel with the recently announced decision to re-form the Tactical Transport Group (38 Group) which we had in War, the short-range force has started to expand. At the initial stage reached thus far, it comprises two composite squadrons in which the theatre elements in use overseas are now directly represented at home.

The Metropolitan Communications Squadron, as its name implies, is not a tactical squadron, but within it is represented also the short-range family of transport aircraft for passenger carrying and air-ambulance duties within the home theatre.

As regards the future, Sir Denis said of short-range transport for the more intimate forms of support of fighting troops in forward areas of engagement that it is in this family, because it is small today, that a more substantial expansion is needed, both in numbers and in types, than in any other.

Secondly, at the long-range end of the scale, he reiterated his conviction about our prime continuing need for really high and progressively contemporary performance in at least an element of our strategic fleet, in perpetuity.

Cyprus Honours

IN the *London Gazette* for February 9 was a list of awards to R.A.F. personnel in recognition of distinguished service in Cyprus.

Air Vice-Marshal C. T. Weir, C.B.E., D.F.C., appointed C.B., Wg. Cdr. J. F. Oliver an O.B.E., and Flg. Off. A. E. Jones, R.A.F. Regiment, and Plt. Off. A. Greenhalgh appointed M.B.E.s The A.F.C. is awarded to Flt. Lt. K. W. Woodcock and Ch. Tech. T. V. Morgan receives a B.E.M.

Learning About Arctic Survival

A TOTAL of 35 Combat Survival Officers are off to northern Norway shortly to learn how to guard against exposure if suddenly faced with the sub-zero temperatures of the Arctic without benefit of special protective clothing or equipment. They are to attend winter survival courses held by the Royal Norwegian Air Force designed to teach them how to remain alive, their faculties unimpaired, if precipitated into freezing conditions as the result of a flying accident.

Flying to Oslo, the officers will spend a few days at the nearby R.N.A.F. Station at Rygge familiarizing themselves with Arctic equipment. Then, accommodated in ski huts at Vesle Skougum near Gol within the Arctic Circle, they will get to know the terrain and practise traversing its frozen lakes and mountains on skis. Survival crafts they are to learn include the construction of snow caves; shelters out of timber; the use of parachutes as sleeping bags and shelter covers; the fashioning of snow-shoes from timber, fastened with parachute cord; and sleigh stretchers from aircraft parts and the limbs of trees.

Two days in a shelter of their own construction and a 15-mile ski-trek complete the course.

R.N.Z.A.F. Reorganization

WITH the inauguration of a ground training wing, Wigram South Island has become the principal R.N.Z.A.F. station in New Zealand. Defence planning proposals envisage Wigram being fully established as a ground unit after flying training ends at the station, probably within the next two or three years.

Another move in the reshaping of the Service's establishments will be the closing of Weedons as a R.N.Z.A.F. station this month. Wigram will take over the rôle of a movement unit from Weedons and also assume responsibility for the bulk stores there.

The Aviation Medicine School at Ohakea, North Island, will be transferred to Wigram before the end of this year, the latter already having a well-established aviation medicine unit. The only remaining R.N.Z.A.F. ground establishments other than Wigram after the end of this year will be the technical trade training schools at Woodbourne and Hobsonville, and the boy entrant school at Woodbourne.

A Great Man

JOHNNY CHICK (see THE AEROPLANE for Jan. 29 last) was one of the most colourful characters in the R.A.F., at a time when the Service was dependent on such characters—when indeed it had nothing but good men—no aircraft worthy of the name, and no money worth counting.

He was an extraordinarily fine leader. Whether it was a rugger scrum, a flight, or an aerobatic team at the Hendon Display Johnny could exercise his power and charm in balanced proportion, and with great effect. His flying of little aeroplanes as exemplified by his leadership of five underpowered inverted Moths in formation or his handling of a "heavy," demonstrated his craftsmanship. His playing of a violin, though not of concert standard, showed that his massive physique was under very precise emotional control. His football was as energetic and effective as the vocal power which always accompanied it.

An incident of flying can be told affectionately against him. He had a very foreign pupil once at C.F.S. to whom he was teaching slow rolling in an Avro 504. The pupil elected to do another one, after the exercise, and at a point where Johnny for some reason had released his harness. Out fell Johnny, but one of his great fists managed to get engaged on the harness bar of the front cockpit, Johnny dangled in space yelling the completion of the "patter" and as his pupil completed the roll, fell back into his cockpit. It was typical of him that he merely congratulated the man on having completed a roll entirely on his own.

Johnny was an outstanding personality in an outstanding generation, and I am sure that many Senior Officers must be grieving at his death, as does your correspondent. W.E.P.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. P. W. D. Heal, A.F.C., and Wg. Cdr. C. Pattison, to the Department of the Air Member for Supply and Organization, the latter with the acting rank of Gp. Capt.; Wg. Cdr. L. J. M. Bunce to the Department of the Air Member for Personnel; Wg. Cdr. E. L. Bloxham, O.B.E., to the Department of the Chief of the Air Staff.

Bomber Command: Wg. Cdr. H. R. Allen, D.F.C., to R.A.F. Wyton to command the administrative wing; Wg. Cdr. M. Hermiston, M.B.E., A.F.R.Ae.S., to Headquarters for technical planning duties.

Fighter Command: Gp. Capt. F. F. Kennedy, L.D.S., to Headquarters as Principal Dental Officer; Wg. Cdr. R. Aytoun, D.F.C., to the Central Fighter Establishment, to command the tactics section.

Coastal Command: Wg Cdr. D. A. Reddick, O.B.E., D.F.C., A.F.C., to Headquarters for Air Staff duties.

Flying Training Command: Wg. Cdr. E. E. M. Angell, A.F.C., to the Ground Officers Selection Centre, R.A.F. Biggin Hill, as Board President; Wg. Cdr. J. Lee to R.A.F. Little Rissington as Senior Technical Officer; Sqn. Ldr. N. F. Ruse to No. 8 Flying Training School, R.A.F. Swinderby, as Senior Technical Officer, with the acting rank of Wg. Cdr.

Technical Training Command: Gp. Capt. G. W. Hargreaves, L.D.S., to Headquarters No. 22 Group as Principal Dental Officer; Wg. Cmdr. W. B. McStay, L.D.S., to R.A.F. Henlow as Senior Dental Officer; Wg. Cdr. H. M. Shephard, O.B.E., to No. 4 R.A.F. Police District as Assistant Provost Marshal.

Maintenance Command: Wg. Cdr. K. H. Burns, D.S.O., D.F.C., to Headquarters, No. 40 Group, for operations duties.

British Forces Arabian Peninsula: Gp. Capt. G. B. Walford, O.B.E., to the Persian Gulf as Senior R.A.F. Officer.

Other Appointments: Gp. Capt. I. J. Lightfoot and Wg. Cdr. A. A. Pedder, both to the Ministry of Aviation.

More Service News

Auxiliary Award.—The only Fighter Control Unit in Metropolitan London, No. 3604 F.C.U., R.Aux.A.F., has been awarded the Efficiency Trophy for units of No. 11 Group, Fighter Command. The Trophy was presented to the C.O., Wg. Cdr. A. R. Smallwood, by the A.O.C., No. 11 Group, Air Vice-Marshal A. Foord-Kelcey, earlier this month.

Service Winners.—A significant proportion of awards made so far under the Duke of Edinburgh's Award Scheme has gone to R.A.F. apprentices and boy entrants and to cadets of the Air Training Corps. Since the scheme was instituted, in 1956, 28,000 boys have taken part in it, of whom 7,698 have been awarded gold, silver and bronze badges. The R.A.F. and A.T.C. share of the honours is 612.

Technical Commissions.—Short service commissions in the R.A.F. Technical Branch are again being extended to young men without any professional qualifications. Required for work on radar and electronic equipment, they will receive a year's course in electronics and engineering at the R.A.F. Technical College, Henlow.

BRISTOL'S F

HALF a century of aeronautical endeavour by The Bristol Aeroplane Co., Ltd., was achieved today, February 19. When the company began building aeroplanes in 1910, it was little more than six years since the Wright brothers had achieved their first powered flight at Kitty Hawk. Bristol's first half-century of existence therefore covers almost the entire span of powered flight, for after the historic flights in 1903, progress languished until 1908.

History of the company has been a chequered business, with violent wartime expansions followed by difficult readjustments to reduced peacetime demands. Technologically, the company has travelled from the primitive "stick-and-string" biplane, whose flights were measured almost in yards, to the 130-seat airliner which flies the Atlantic as a matter of daily routine; from the 350 h.p. radial engine which was put into production in 1920, to the 100,000 h.p. ramjet.

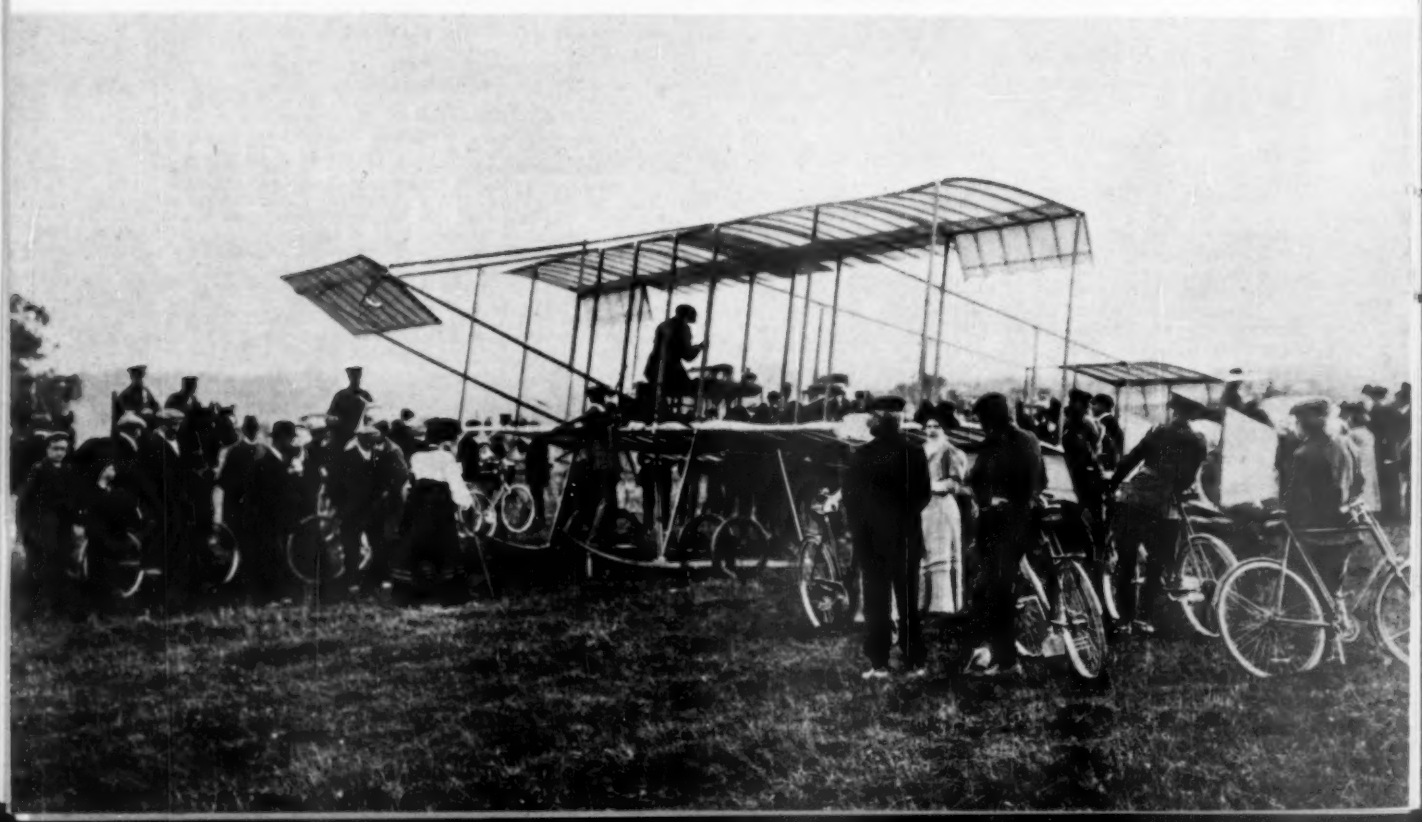
The company set up in business as The British and Colonial Aeroplane Company and its beginnings were modest, as befitted an organization with a capital of £25,000. It occupied a house and a few adjoining sheds on a two-acre site at Filton on the northern outskirts of Bristol. Its founder, Sir George White, Bt., who had been a pioneer in electric tramways development, was one of the few eminent business men of his time to recognize the commercial and military potentialities of aviation.

From the beginning the company operated on sound commercial lines and rapidly took a prominent position among its competitors. The first Bristol aircraft, the Boxkite biplane, was in production only a few months after the company's formation. A Boxkite had the distinction of making the first military flight in history when, flown by Capt. Bertram Dickson, it was used in a reconnaissance rôle in British Army manœuvres on Salisbury Plain in September, 1910.

Within a matter of a few months the company was planning for expansion and mounting its first overseas sales drives. Sales missions were dispatched to Australia, India and other countries with good results. Bristol aircraft were sold to Russia, Sweden, Spain, France, Italy, Turkey, Rumania and Bulgaria.

In those early days the training of pilots was one of the company's major activities. At its flying schools at Larkhill and Brooklands, hundreds of pilots, including some of aviation's future great names, learned the rudiments of their craft. It is a measure of the company's predominance in this field that half the total of British pilots who had gained R.Ae.C. brevets up to 1914 were Bristol-trained.

At the same time, important experimental work was undertaken, notably in an attempt to develop a hydrofoil flying-boat for naval use. Although this objective was not achieved, the knowledge gained by Lieut. (later Sir Charles) Dennistoun Burney in collaboration with the company led to the invention



IFTY YEARS

of the Paravane device which protected merchant ships and facilitated mine-sweeping.

World War I brought the first of the "slam accelerations" to which the much-tried British aviation industry machine has been subjected. However reluctantly, Governments and military authorities had to accept the fact that aviation, so far from being the preserve of enthusiastic sportsmen or visionaries, was an essential element of the military resources of the country.

The first Bristol type to enter war production was the single-seat Scout, designed by Capt. F. S. Barnwell. In 1916 Barnwell designed the famous Bristol Fighter F2B, the first true two-seat fighter, which was one of the outstandingly successful Allied aircraft of the later war years. Over 4,500 fighters were built, some of them by firms outside the industry participating in the first "shadow" production scheme.

Other Bristol wartime designs included the M1C high-wing monoplane fighter and the Braemar four-engined triplane bomber. The M1C saw service in the Middle East and, operating with the Chilean Air Force, made pioneer flights over the Andes. From the Braemar, which did not go into production because of the ending of hostilities, was developed the Pullman fully enclosed airliner.

The company adopted its present title at the end of 1919. In the following year, after acquiring the manufacturing rights in the Cosmos radial engines, Bristol formed an Aero-Engine Department. With the engine market flooded by War surplus units, this appeared an almost recklessly bold decision, but perhaps no decision in the company's history has been more fully justified by subsequent events.

Under the technical leadership of Roy Fedden (later Sir Roy Fedden) who was its chief engineer from 1920 to 1942, the new department type-tested its first engine, the air-cooled, nine-cylinder radial Jupiter, within a year of its formation. This was an auspicious début, and the Jupiter went on to establish standards of engineering efficiency, workmanship and reliability which its successors have worthily upheld. Jupiters powered many types of aircraft and at one time were being manufactured under licence by 16 countries.

Next came the supercharged Mercury and Pegasus types. Engines in the latter series were used in establishing no fewer than four new World altitude records.

In contrast to the Engine Department, activity in the company's aircraft shops was for most of the 'twenties at a reduced level. Research and development work continued, but few military contracts were being placed by the Government, and civil aviation made slow headway. Full-scale production was not resumed until 1929 when the all-steel Bristol Bulldog was selected as the standard day-and-night fighter for the Royal Air

Above, one of the most famous of a long line of Bristol aeroplanes, the turboprop Britannia is in World-wide airline service covering more than 3,000,000 miles per month.

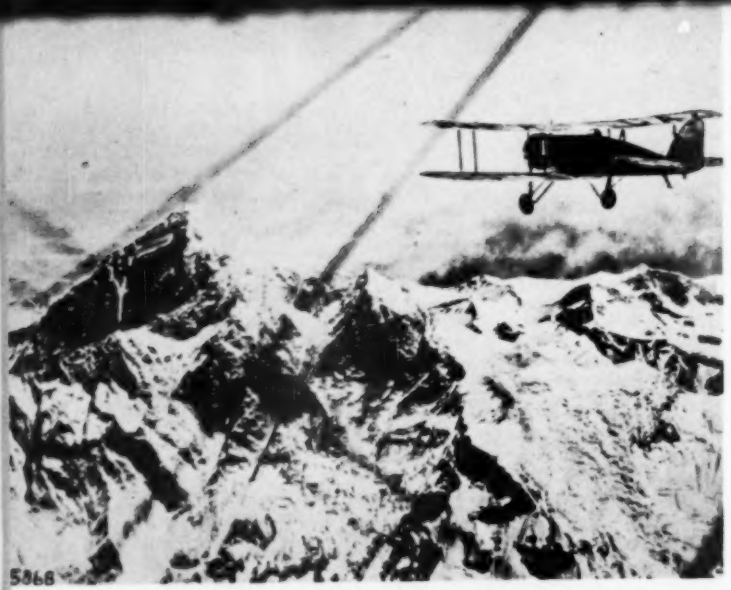
Left, a typical scene from the early days of aviation with a Bristol Boxkite being prepared for flight during British Army manœuvres on Salisbury Plain in 1910.

Right, another very successful Bristol aeroplane was the wartime Beaufighter—of which nearly 6,000 were built.

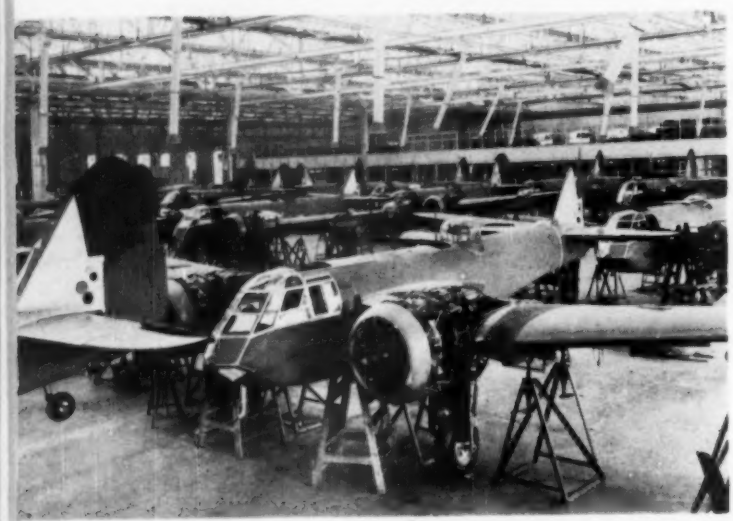
Below, a Bristol fighter of the first World War; this is the only surviving airworthy example.

Below right, the Bulldog of 1929 was the R.A.F.'s standard day-and-night fighter at that time.

Bristol's Fifty Years . . . .



Powered by a special Pegasus one of the two Westland biplanes of the Houston expedition flies over Mount Everest in 1933.



More than 4,500 Bristol Blenheims had been built by the time production ceased in 1942.

An early assembly line of Bristol aero-engines—Jupiters and Lucifers—in 1922.

Force. This machine remained in production until 1934 and was also sold overseas in substantial numbers.

In the early 'thirties the company produced a design for a fast twin-engined transport monoplane in which advanced use was made of stressed-skin construction. This aroused the interest of the late Lord Rothermere who agreed to sponsor the building of a development, known as the "Britain First." During official trials in 1935 this monoplane startled Service authorities by achieving a top speed of over 300 m.p.h., some 50 m.p.h. faster than that of any fighter then in service.

In many other ways 1935 was a turning point for the industry. The Government announced in May of that year their plans for a massive increase in the front line aircraft strength of the Royal Air Force. To meet this challenge the directors, realizing that the company's capital resources were inadequate, resolved on June 15 to reorganize the firm as a public limited liability company.

With the call for new equipment in what then seemed staggering quantities emerged a new race of aircraft—clean, efficient monoplanes with cantilever wings, metal semi-monocoque fuselages and retractable undercarriages. These aircraft were powered by improved supercharged engines driving variable-pitch propellers and giving enormously increased output.

The company was well placed to serve these requirements—both in the airframe and engine fields. From the Type 142—Lord Rothermere's "Britain First"—was soon evolved the famous Blenheim design and its equally famous successors. The Type 130, prototype of the Bombay transport, was also well advanced.

Moreover, research into the sleeve-valve engine, begun as far back as 1926, had also come to fruition with the Perseus, followed by the Taurus, Hercules and Centaurus.

By 1936, the company was faced with aircraft and engine production on an unprecedented scale. This problem was overcome by the Government's "shadow production" scheme using automobile factories. Engines chosen for manufacture under the scheme included the Mercury, Pegasus, Perseus, Hercules and Centaurus.

At the outbreak of War, Bristol was making a major contribution to the growing strength of the Royal Air Force. Within 45 minutes of the declaration of War, Blenheims took-off on the R.A.F.'s first offensive operation against the enemy—a reconnaissance of the German fleet in the Schillig Roads. Twenty-four hours later Blenheims shared in the first R.A.F. bombing sortie, an attack on the fleet as it lay at anchor.

From that day onward, Bristol aircraft and engines were constantly in action. Development of the Blenheim had led to the Taurus-powered Beaufort torpedo bomber and then to the Beaufighter, which first flew in the summer of 1939 and was in front-line squadron service just a year later.

Bristol-designed machines saw service with every R.A.F. Command and in every theatre of War save Russia, while Bristol engines powered aircraft of every class employed by the R.A.F.

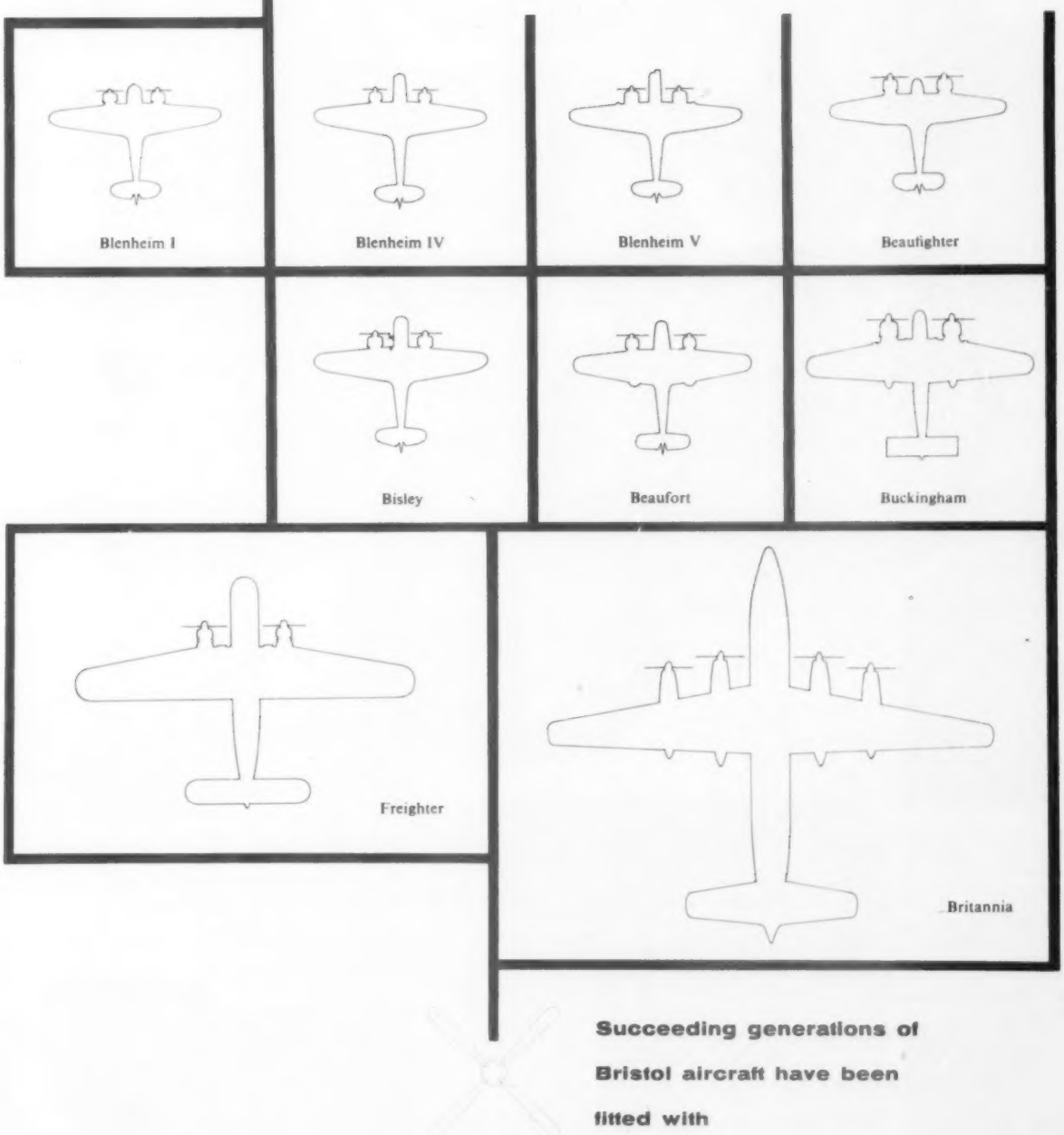
In all, well over 14,000 Bristol aircraft and more than 100,000 Bristol engines—over half of them Hercules—were produced during the Second World War. The importance of Bristol's War contribution was not overlooked by the enemy; in a single daylight air-raid on Filton in September, 1940, 91 workers were killed. From the 1935 payroll of 5,500, the numbers had swollen to a peak of 52,000 employed in something like 150 premises up and down the country.

In 1945, with about half this number still on the payroll, The Bristol Aeroplane Company was again faced with the prospect of readjustment from War to peace. This problem was tackled by a simultaneous attack on a variety of advanced projects. To begin with, there was the Brabazon, then the World's largest landplane. There was the private venture Type 170 Freighter, one of the most successful post-War British aircraft. There was the formation of the Helicopter Department which produced the Type 171 Sycamore, the first British helicopter to gain a Certificate of Airworthiness. This was followed by even more advanced designs such as the twin-engine tandem-rotor Type 173 helicopter, forerunner of the Type 192 military machine now in production for the R.A.F. Somewhat later a Guided Weapons Department was formed to undertake Bristol's entry into the missile field.

On the engine side, preliminary work on gas turbines had already been started before the end of the War. The company's initial venture in this field, the Theseus, became the first turbo-prop engine to pass an official type test and the first to enter regular operational service. Its successor, the Proteus, power-plant of the Britannia, has, under Dr. S. G. Hooker, become one of the most reliable engines of its type in civil and military operation. It has also been successfully adapted as the power

(*Continued on page 224*)

Congratulations to Bristol on their 50th anniversary



Succeeding generations of Bristol aircraft have been fitted with

DE HAVILLAND PROPELLERS

Freeze up

Low temperature lowers activity in all sorts of things; the flow of bees from the hive slows down, the oil in the engine flows more slowly. It's just as true in aviation. For this reason much AIR BP research activity has been devoted to low temperature performance of aviation fuel—towards the prevention of icing troubles and the preservation of perfect pumpability at the deep-freeze levels around 50,000 feet altitude.

Water separation equipment has achieved the first end, and the free water content of BP fuels as delivered is no higher than 30 parts per million.

Precisely judged refining has likewise established that BP aviation fuels remain fluid at temperatures far below those encountered in service.

AIR BP

THE AVIATION SERVICE OF BRITISH PETROLEUM

LONG-SERVICE MEN AT BRISTOL

Some of the members of the Bristol aircraft and aero-engine teams who have been with the company since its earliest days.

Photographs copyright "The Aeroplane and Astronautics"

A. Houlson (Sept., 1920), detail draughtsman, aero-engine engineering department.

W. H. Sparkes (May, 1917), superintendent, inspection, aircraft company.

R. Smith (June, 1913), inspector, standards room, aircraft company.

V. J. Sullivan (Dec., 1917), detail fitter, development powerplant department.

R. W. Powell (Feb., 1917), superintendent, millwrights, aircraft company.

K. Hayward (Oct., 1917), general works manager, aircraft company.

W. G. Morgan (July, 1911), assistant chief designer, project design, aircraft company.

J. F. Featherstone (Dec., 1920), development manufacture (No. 4) shop, aero-engines.

A. J. Bradford (July, 1912), assistant chief estimator, aero-engines.

H. R. Jones (Nov., 1912), section leader, contracts development, aero-engines.

F. J. Hemmings (April, 1916), tool fitting department, aero-engines, Rodney Works.

A. Symon (June, 1919), manager, sales engineering, aircraft company.

J. C. Joslin (May, 1915), fitter, Britannia shop, aircraft company.

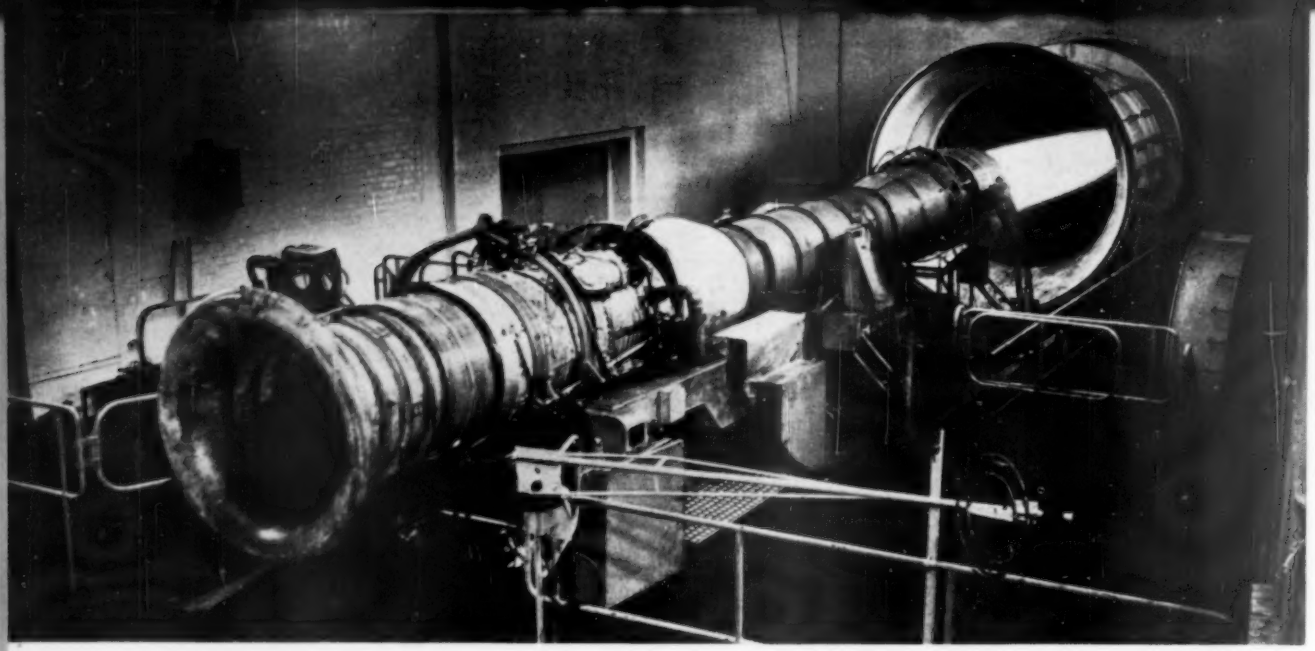
V. P. Viner (April, 1916), senior planner, aircraft company, planning department.

G. Rubery (Feb., 1917), senior foreman, production machine shop, aircraft company.

W. L. Chalker (March, 1929), safety officer, aircraft company.

J. L. Pope (Nov., 1911), clerk, issue department, engineering, aero-engines.

S. R. Jones (July, 1918), chief estimator, aero-engines.



One of the most powerful type-tested turbojet engines of today is the Bristol Siddeley Olympus which is in production as a powerplant for the Avro Vulcan and is being developed for the new TSR.2.

Bristol's Fifty Years . . . .

unit for high-performance sea-going craft and as the prime mover of advanced types of electrical generating equipment.

In the early post-war years, diversifications had taken the company into fields other than aviation. First, into the production of lightweight, prefabricated buildings; this activity ceased in 1955 by which time the acute shortages of conventional building materials had been made good. Secondly, into the manufacture of the famous Bristol line of de luxe high-performance motorcars.

The most important single Bristol project in the post-war era was the Britannia airliner under Dr. A. E. Russell. First flown in August, 1952, this aircraft, still today the largest and fastest turboprop airliner in international service, has set new standards of reliability, safety and passenger comfort. Eighty Britannias have been sold, and are in service with six major airlines and with R.A.F. Transport Command. Britannia airliners, operating on a World-wide network, are at present covering well over 3,000,000 miles a month on revenue service.

As a result of the post-war growth in the company's business, a major reorganization took effect in 1956. The manufacturing and sales activities of the Aircraft, Aero-Engines and Car Divisions were reconstituted in three subsidiary companies, Bristol Aircraft, Ltd., Bristol Aero-Engines, Ltd., and Bristol Cars, Ltd. The Bristol Aeroplane Company, Ltd., remained as the holding company. In view of its increasing international commitments, Bristol has, during the past 10 years, set up subsidiary companies in Canada, Australia, New Zealand, Sweden, Mexico and Cuba.

An ever-increasing share of the company's resources has in recent years been devoted to guided-weapons development. In 1957 it was announcd that the Bristol/Ferranti Bloodhound had been selected by the R.A.F. as its surface-to-air guided-missile system for the air defence of the United Kingdom. Bloodhound has also been ordered by Sweden and Australia. An advanced version is under development for the R.A.F.

One of the more important post-war activities by Bristols has been entry into the guided missile business; here is a Bristol/Ferranti Bloodhound surface-to-air weapon of the type that is in production for the R.A.F. and ordered by Sweden and Australia.

Just as the Theseus and the Proteus pioneered the free turbine, so the high-thrust Olympus, the company's first pure jet engine, introduced another Bristol concept, the "twin-spool" principle. Olympus-powered aircraft have twice broken the World's altitude record, and the current version, the Olympus 201, which powers the R.A.F.'s Vulcan bomber, has a take-off thrust of 17,000 lb. A development of this engine has been specified for the TSR.2, the R.A.F.'s future tactical/reconnaissance aircraft.

The second Bristol venture in the turbojet field was the lightweight medium-thrust Orpheus, which first ran in 1955 with an initial thrust of 3,285 lb. Development has continued rapidly, and the latest version has a thrust of over 8,000 lb. (with reheat). Engines of the Orpheus family have been specified as the powerplant for a total of 14 different types of aircraft.

Bristol was the first company in this country to develop and produce ramjet engines, and is still the only British manufacturer with a ramjet in production. Bristol Thor ramjets power the Bloodhound guided missile.

In conformity with the trend towards larger groupings within the industry, two great names in British aviation, Bristol Aero-Engines, Ltd., and Armstrong Siddeley Motors, Ltd., united in April, 1959, to form Bristol Siddeley Engines, Ltd. This new giant, one of the largest aero-engine manufacturing units in the World, is jointly owned by The Bristol Aeroplane Co., Ltd., and Hawker Siddeley Group, Ltd.

Another major development occurred last month when The Bristol Aeroplane Co., Ltd., Vickers, Ltd., and English Electric, Ltd., announced that they had decided to amalgamate their aircraft and guided-weapon interests into a single new company. Henceforth, Bristol Aircraft, Ltd., will be, with Vickers-Armstrongs (Aircraft), Ltd., and English Electric Aviation, Ltd., a wholly owned subsidiary of the new company but will retain its name and identity. This new consortium must rank among the World's largest aircraft and missile manufacturing units, and the combination of the design, research and production facilities and experience of Vickers, English Electric and Bristol will place it in a strong position to confront future international competition.

Rocket development using solid propellents is being pursued by Bristol Aerojet, Ltd., which was formed in association with Aerojet-General Corporation Inc. of California. Negotiations are proceeding for the acquisition of Bristol's helicopter division by Westland Aircraft, Ltd.

All the companies in which Bristol is associated are pushing ahead with research and development on a very broad front. Much of this work is necessarily proceeding behind security barriers, but Bristol Siddeley's BE 53 and BE 58 ducted fan engines and Bristol Aircraft's Type 188 supersonic research aircraft are examples of projects in hand.

The outcome of these and other current Bristol activities will form part of the history of the next half-century.

Supersonic Considerations in the U.S.

PRESSURE on the U.S. Government to support the development of a commercial supersonic transport is mounting. The question of a subsidy for this development is being considered by the Aviation Sub-Committee of the Senate Interstate and Foreign Commerce Committee, under the chairmanship of Senator A. S. (Mike) Monroney. To this committee, Mr. James Durfee, chairman of the C.A.B., recently addressed a letter claiming that Britain and Russia "are known to be subsidizing the development of supersonic transport aeroplanes" and that U.S. manufacturers "may lose to foreign competition unless they receive prompt help and money from the Government."

A delay of one to three years in development by U.S. manufacturers "might mean that some time in the early or mid-1960s the U.S. long-range carriers may be forced by competitive reasons to place orders for supersonic aircraft in other countries," said Mr. Durfee, according to B.U.P. "If this happens, the favoured position enjoyed by U.S. civil aircraft manufacturers might be lost for decades."

Mr. Durfee said that Boeing, Convair, Douglas and Lockheed could each turn out a supersonic model "given proper financial encouragement." One of these manufacturers had said it could have a prototype flying in about three years—given adequate assurances—and could deliver standard production models by about 1967.

Senator Magnuson said that Mr. Durfee's letter confirmed his worst fears that America's leadership in commercial passenger and cargo jet aeroplanes was in grave jeopardy.

These views may read oddly to a British industry which is itself struggling to gain Government support for a supersonic transport. Mr. Durfee's reference is presumably to the work already done by and for the Supersonic Transport Aircraft Committee (S.T.A.C.) and the research contracts placed by the M.o.A. for, among other items, the Handley Page H.P.115 low-speed slim delta. There is little doubt, however, that it is the possibility of a Russian supersonic transport being developed which has really worried the U.S. industry and politicians—and which will almost certainly result in some form of subsidy being agreed in the near future.

That Russia, rather than Britain, is the nigger in the woodpile is confirmed by the papers presented at the 2nd Supersonic Transport Symposium of the I.A.S., held in New York at the end of January. Two of the four papers dealt specifically with the question of national prestige and the threat of competition; both mentioned Russia and neither mentioned Britain. Two quotes, one from each paper, will serve to indicate the U.S. industry's views:

"Unless as a nation we want to risk lagging behind the U.S.S.R. in the introduction of supersonic transport . . . we must start an aggressive development programme without further delay" (Pearson and Pfeiffer).

"In the supersonic transport, the U.S. has an opportunity to demonstrate to the World its technological leadership over the Soviet Union. In our opinion, the Government would be justified in supporting the development of a supersonic transport simply for national prestige. . . ." (Monesmith and Bailey).

How serious is the Russian threat? To this question no valid answer can be given beyond the facts that a supersonic delta-wing bomber is flying in Russia and that Mr. A. N. Tupolev is reported to have said, when the question of a Mach 3 transport came up, that "in essence an aircraft of this type could be built with present knowledge." In the U.S., this was taken to mean that the subject had been given more than a cursory examination in the Soviet Union.

How serious is the British threat? Most readers probably have their own firm views on this point, and few, perhaps, would be optimistic about our prospects if the terms of the competition were an immediate start by both the British and American industry and a Mach 3 speed bracket. As there is no doubt that the first U.S. supersonic transport will be designed for Mach 3, Britain might still creep under the post with an interim Mach 2 design—despite the "grave danger of early obsolescence" of such an aeroplane referred to by American industry speakers.

The American manufacturers, while waiting hopefully for a benevolent Government to disgorge a few hundred million dollars, are not standing still. The extent of design studies and wind-tunnel research already undertaken by Boeing, Convair, Douglas, Lockheed and North American is enormous —14,000 wind-tunnel hours on Mach 3 configurations have been accumulated by the last-named company alone, to mention but one spot figure.

Many of the conclusions reached by these companies have already been made known, and have been reviewed in our pages. The latest I.A.S. series served to bring the picture up to date, and three of the four papers are summarized below. Out of all the interesting information contained in these summaries it is worth underlining just one fact: in the considered view of North American Aviation, a prototype U.S. Mach 3 airliner could be flying in 1963.

The North American View

"Supersonic Transports—Considerations of Design, Powerplant and Performance" by J. B. Pearson, Jnr., corporate director, development planning, and R. James Pfeiffer, manager, commercial aircraft marketing, North American Aviation Inc.

TO provide a framework in which to consider the design, powerplant and performance of a supersonic transport, the authors of this paper postulated the following design requirements: range, 3,500 nautical miles with fuel reserves; cruising speed, Mach 2 to 3; cruising altitude, above adverse weather; passenger loads as dictated by economic factors; operating costs less than 3 cents per seat-mile; noise limitations comparable with present jet transport levels; take-off requirements, equivalent to a 10,500-ft. runway length at sea level.

A low-aspect-ratio (or narrow) delta-wing planform is suggested, with a fuselage length greater than that of present subsonic jet transports, in order to keep down the cross-sectional area and therefore the aerodynamic drag. A canard (forward tail) arrangement provides for the least drag at supersonic cruising speeds and results in the highest trimmed lift for take-off and landing.

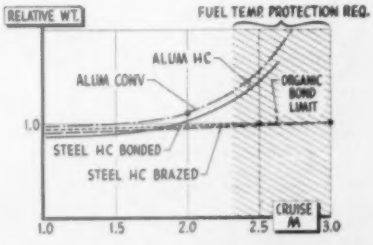
A variable geometry windshield may be necessary, but there is a possibility that a low-drag fixed canopy can be designed to satisfy the F.A.A. and S.A.E. Doors, escape hatches and windows can be designed to permit reliable supersonic operation at 80,000 ft., but the windows in a typical 100-passenger transport would cause an increase of 4% in the gross weight (at a growth factor of 6) and might not be justified.

A choice is made in favour of buried engines, for reduced drag and reduced structural weight. Engines submerged in the fuselage, with tail pipes extending to the rear of the fuselage, offer the best solution.

The layout thus described is, in fact, exactly similar to that of the B-70 (see page 236) and confirms that North American designs for a supersonic transport are based on this Mach 3 bomber. The paper under review notes that North American has accumulated some 14,000 hr. of tunnel testing on Mach 3 configurations; much of this time, presumably, was in connection with the B-70 programme.

A study of structural considerations shows that, up to speeds of about Mach 2.3, aluminium alloys may be used, but steel or titanium has to be introduced in various structural components above this speed and, by about Mach 2.6, must replace aluminium in virtually all parts of the airframe structure. The use of honeycomb sandwich is indicated by requirements arising from aerodynamic heating of fuel, low-aspect-ratio delta-wing planform, acoustical fatigue, and the employment of higher density materials.

Three types of powerplant have been considered and no clear choice can be made at present between the "dry" turbojet, the afterburning turbojet and the turbofan. The "dry" turbojet at



The influence of Mach number on choice of structures.

Supersonic Considerations . . . .

present offers the lowest specific fuel consumption at supersonic speeds and the afterburning turbojet has the lowest installed weight.

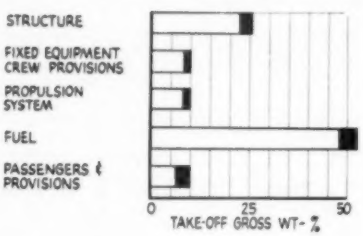
The turbofan is best in terms of noise level and subsonic cruise fuel consumption, and represents the best compromise if a fan-burning system can be devised to improve the supersonic performance. Rectangular jet nozzles are being studied and may help to reduce noise levels.

North American note that the whole of their suggested time-scale for development of a supersonic transport (first flight, 1963, scheduled service, 1965) depends on the development of a suitable engine being urgently pursued, to obtain certification by mid-1963.

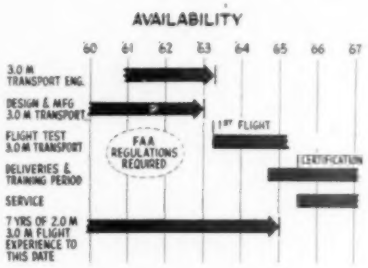
Existing fuels, particularly JP-6, should be suitable for the Mach 2.0-3.0 transport, and fuel systems will be similar to those in use today except for fuel-tank pressurization and use of the fuel as a heat sink for the engines and various items of equipment.

Most of the systems can be modelled on those in use today, but cabin conditioning and pressurization will be of greatly increased importance. Compared with a ram-air system for environmental control, a stored-air breathing system seems preferable, being lighter and more reliable and requiring less power (200 h.p. against 900 h.p.). Such a system comprises a supply of bottled air, a recirculating loop, a cooling loop and a heat sink. An emergency ram-air system would be able to maintain a 20,000-ft. equivalent altitude at all higher altitudes and oxygen masks would be provided.

The primary flight-control system must be fully powered and irreversible. Direct-driven power-generating systems are suggested to provide the power demands, which are 10 times as great as on present transports. Electrical requirements are not excessive and no great change is anticipated in passenger seating arrangements. Maximum nose-up angles may be as high as 14° but will be maintained for only short periods and special seat designs appear to be unnecessary.



A weight statement for a Mach 3, steel honeycomb transport for 3,500-naut.-mile stages.



A possible programme for supersonic transport development.

Automatic programming of flight-deck functions, such as radio tuning, fuel scheduling, autopilot settings, trim controls and others, will leave the crew free to concentrate on monitoring the aircraft and its equipment.

An abbreviated weight breakdown shows that, in the aircraft described, with a weight of not less than 300,000 lb. for a 3,500-naut.-mile stage length at Mach 3, fuel would account for half the total and structure a quarter. Every pound of additional fixed weight increases the take-off weight by 6 lb. if performance is to be maintained; and if the additional item affects the drag characteristics, this weight growth factor could be as high as 10.

Operation and Finance

"Operational Factors, Financial Considerations and National Policy" by B. C. Monesmith, vice-president and general manager, and Robert A. Bailey, chief engineer, Lockheed Aircraft Corpn., California Division.

DURING the past year thorough investigation by Lockheed of several of the problem areas, which had once seemed unsurmountable, has shown that immediate and practical solutions are possible with no compromise in operating economics. They are discussed in this paper under the main headings of airport operational problems, passenger comfort and flight operations, followed by a section on financial considerations.

Because the power-to-weight ratio of a Mach 3 transport will be higher than for the subsonic jets (a value of 0.32 is mentioned) there will be no problem in operating from existing 10,500-ft. runway lengths, and, because of low wing loadings, at 40-45 lb./sq. ft., landing distances will not be critical.

The airport noise problem is also expected to be reduced, because of the much steeper climb-out angle made possible by the high-thrust engines necessary for supersonic flight. The P.N.Y.A. maximum tolerable level of 112 PNdb should not be exceeded outside the airport boundaries.

For cabin pressurization and conditioning Lockheed favour a ram-air system, incorporating a supercharger (with two emergency stand-bys), ozone removal equipment and a Freon vapour refrigeration cycle. The use of the fuel as a heat sink is being studied but has not been accepted as the optimum system. Lockheed have developed a means of reducing the ozone content of the atmosphere, at heights above 70,000 ft., from 10 parts per million to one-tenth part per million.

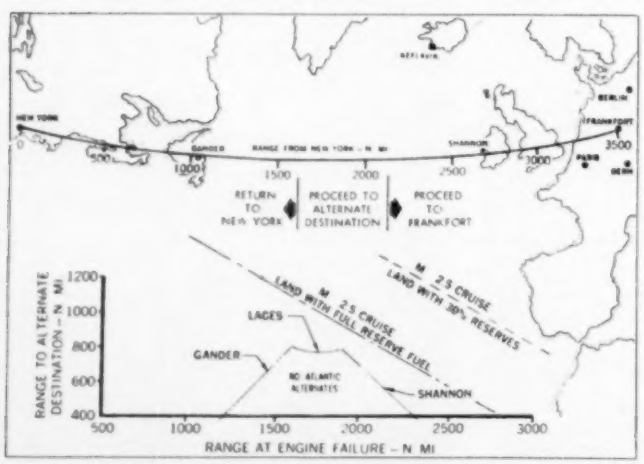
Aerodynamic noise may be a problem in the cabin but should be amenable to soundproofing. Engines will be rear-mounted and most of the cabin will be forward of the wing-body junction, with advantage to the cabin noise level. Floor gradients of more than 10° will be encountered for less than three minutes immediately after take-off and no special seat arrangements are thought necessary. Lockheed research confirms the North American view that windows are structurally acceptable and desirable from the passenger viewpoint.

A typical flight profile described in this paper has an initial climb at 312 knots E.A.S. to 37,500 ft.; level acceleration at 37,500 ft. to 550 knots E.A.S.; climb at 550 knots E.A.S. to the Mach 3.0 initial cruise altitude; "drift-up" cruise at constant Mach 3; descent at 312 knots E.A.S. (starting about 350 naut. miles from destination); approach at 156 knots; and land at 143 knots. The climb profile suggested is the optimum for minimum climb fuel, gust load and aeroelastic effects, and is within the limits described in the paper on noise effects (page 227).

Recent work at N.A.S.A. on a compensated static pressure pitot tube indicates that altitude measurements can be made to an accuracy of within 400 ft. at 70,000 ft. An inertial navigation system should best meet the needs of supersonic operation, with dead-reckoning navigation by a central computer as a back-up.

For short-range navigation VOR will be used, and GCA will provide the normal back-up for dual ILS. Automatic landing devices are desirable, but no more essential than for present aeroplanes. Collision avoidance will be primarily a responsibility of A.T.C.

Reserve fuel, if calculated on the basis of SR427 (applicable to current turbojets) would amount to 17% of the total fuel on a 3,500-naut.-mile stage, compared with 15% for the subsonic



The effect of engine failure on the North Atlantic route, showing that an alternate is always within range assuming 15% fuel reserves are carried.

turbojet. However, 15% reserves may be adequate, as indicated by studies of the en route engine-failure case and the complete cabin decompression case on a North Atlantic crossing. The results of these studies are shown in the two diagrams (page 226 and alongside).

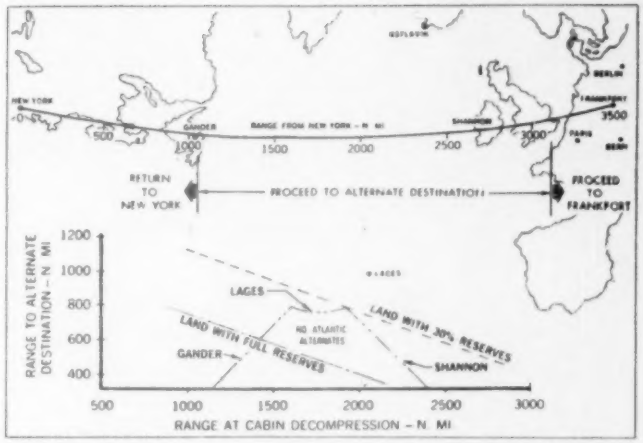
Development and airframe costs were studied for an aluminium Mach 2.4 transport and a steel Mach 3-3.5 type—although the Mach 2.4 project does not warrant consideration because of the grave danger of early obsolescence. Assuming 100 aeroplanes to be built, development costs for the Mach 3-3.5 aircraft range from $160 million to $210,000 million with weights ranging from 250,000 lb. to 500,000 lb.

Lockheed note that the extensive use of steel honeycomb could increase the cost prohibitively, but is not expected to be necessary except in a few critical areas on a small-sized aircraft.

Initial costs vary with weight from $11 million to $20 million for the Mach 3-3.5 aircraft if 100 are built. Costs for the Mach 2.4 run a little lower.

Lockheed traffic projections assume a 10% annual growth rate from 1959. By 1975, 70% of the total World common-carrier traffic (in terms of revenue passenger-miles) will be carried by air and 63% of all air traffic will be by jet aircraft. Route analyses show that the supersonic transport can account for 47% of the jet traffic when operated in an integrated airline system.

Studying a small supersonic transport on a hypothetical airline network comprising 44 stage lengths, Lockheed conclude that this type of aeroplane is economically sound as well as technically feasible. Compared with a present-day subsonic jet moving the same traffic over the same network, the supersonic aeroplane would show a 30% better return on investment. The aeroplane price would be 276% of the subsonic figure; fleet size 39%; block speed 280%; and fleet investment 86%.



The effect of a total cabin decompression on the North Atlantic route, showing that the flight can be continued to the nearest airfield at 20,000 ft. (with passengers using oxygen).

Noise Considerations

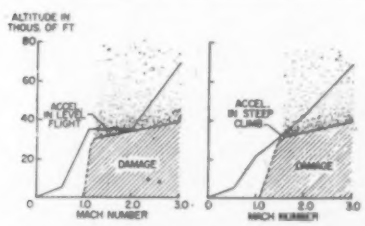
"Supersonic Transports — Noise Aspects with Emphasis on Sonic Boom" by Lindsay J. Lina, Domenic J. Maglieri and Harvey A. Hubbard, Langley Research Center.

Three sources of noise—shock waves, aerodynamic boundary layer and engines—are of significance to designers and operators of supersonic transports, and the first and third of these are important also to the public at large. Tests to date indicate that a Mach 3 transport flying at 70,000 ft. may be audible on the ground over an area 70 miles wide along its flight path.

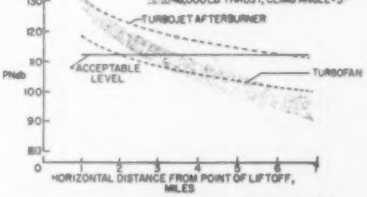
The sonic boom problem is the newest and probably the least understood. The boom (sometimes heard as a double boom) is produced by shock waves from the nose and the tail of the aircraft, and its intensity is influenced by several factors: Mach number, fineness ratio, body length, altitude (distance and pressure gradient), wind direction and velocity gradient, temperature gradient and a few others of minor importance.

Mach number is of small significance once the point has been exceeded where the boom is first produced; doubling the Mach number from 1.5 to 3.0 increases intensity by only about 26%. Much more significant is the distance between the observer and the flight path, both vertically and laterally; doubling the altitude from 30,000 ft. to 60,000 ft. reduces intensity by two-thirds. In tests with military aircraft the lateral spread of the sonic boom from 40,000 ft. at Mach 1.5 was found to be about 20 miles on each side.

Although sonic booms occur at Mach numbers slightly above 1.0, atmospheric refraction causes the shock wave to be curved sufficiently to miss the ground completely over a small range of speeds above this value. The exact "cut-off Mach number" varies with temperature gradient, wind gradient, altitude and flight-path angle, and accurate atmospheric sounding or predictions will be essential for supersonic flight planning if advantage is to be taken of this cut-off point.



Two possible climb paths which avoid combinations of Mach number and altitude likely to cause ground damage.



Noise levels of supersonic turbojet and turbofan transports compared with a subsonic jet (shaded band) now in service.

Changing the flight-path angle (i.e., climb or descent) rotates the whole shock-wave pattern in a manner equivalent to changing the shock-wave angle by changes in speed. Therefore, comparatively high Mach numbers can be achieved in a climb with no boom problems, but speed must be reduced in the descent to eliminate it. In tests, the boom produced by an aircraft climbing at 10° was only one-eighth the intensity for the same altitude and Mach number in level flight.

Some theoretical calculations (based on test results with military aircraft) have been made for a jet transport 200 ft. long, with a fineness ratio of 13, flying at speeds between Mach 1.2 and 2.0 between 20,000 ft. and 70,000 ft. The damage threshold for noise pressures is assumed to be 2 lb./sq. ft., which is, therefore, the highest acceptable value for boom disturbance.

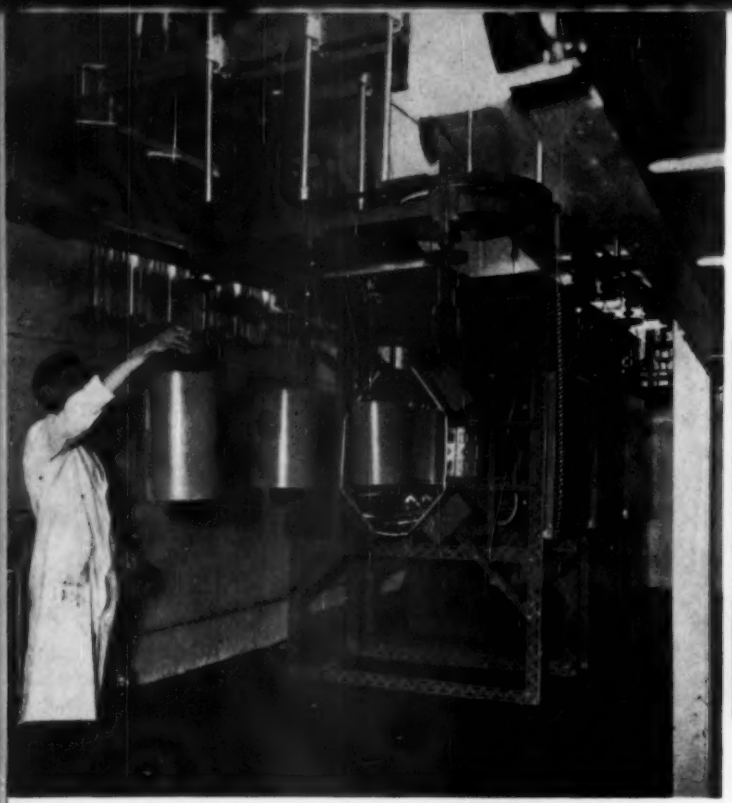
The calculations suggest that level-flight cruise above 60,000 ft. will be satisfactory, but that the climb and descent phases will need careful attention. This is an operating problem, as it is assumed that the aircraft will have been designed for minimum drag and no further aerodynamic refinements will be possible to reduce shock-wave noise.

A steep angle of climb will make possible acceleration to supersonic speeds at a lower altitude than would be the case for level acceleration (for reasons already explained). However, this technique brings the aircraft closer to the Mach cut-off number, which must therefore be assessed accurately for every flight.

Boundary-layer noise is important as a possible source of induced damage to the skin structure, as well as a nuisance to passengers. Surface pressure levels are significantly higher for the supersonic transport than for a Mach 0.8 transport, and noise damage could occur over the rear portion of the airframe surface.

A study of the possible engine-noise levels of a supersonic transport shows a danger of the present-day subsonic jet noise levels being exceeded, even though a 10° climb-out angle is assumed (double the present value). The turbofan engine does, however, promise to keep the perceived noise levels below the arbitrary P.N.Y.A. figure of 112 PNdb.

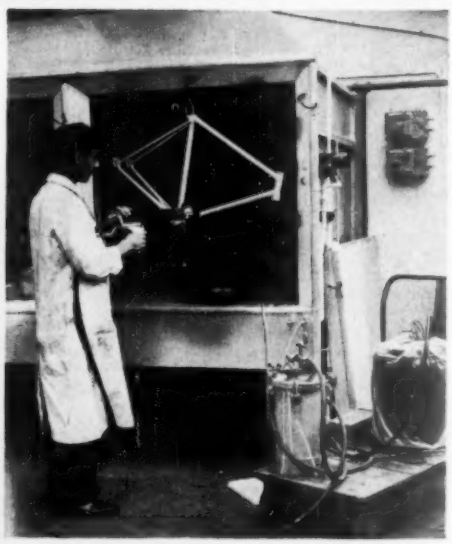
CELLON'S NEW PAINT LABORATORY

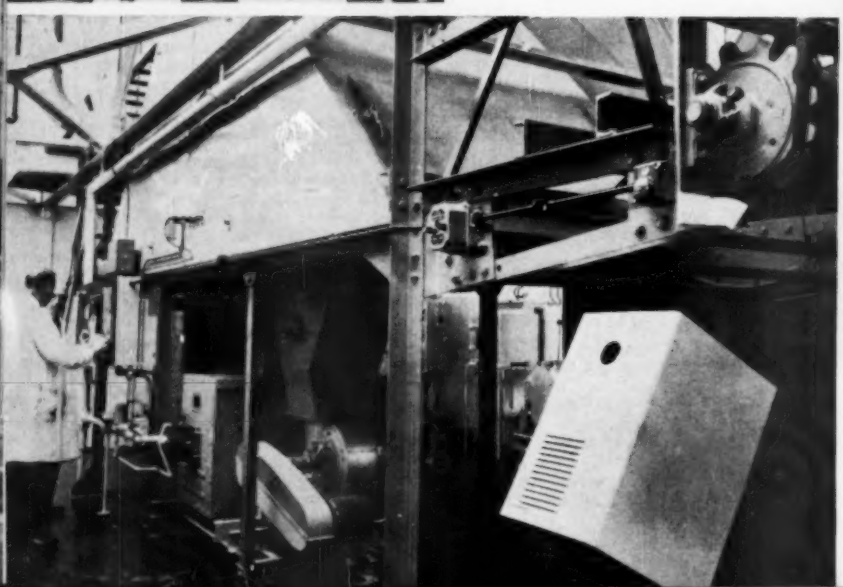


Messrs. N. F. Rose, A. Wallace Barr both of the Cellon board and Mr. John W. Nicholson of Camper and Nicholson.

As noted last week Cellon Ltd. of Kingston-on-Thames have opened a new paint application laboratory at a cost of well over £15,000. Pictures of the comprehensive paint testing equipment appear on this page.

Photographed left at the opening lunch on February 2 is Mr. J. C. Cantrill, recently appointed to the Cellon board. His duties will be specifically connected with the diversification of the Aircraft Industry. With him (right) is Mr. T. Gammon of Vickers-Armstrongs (Aircraft).





Pictures top left, middle, above and left, show respectively an infra-red drying oven, a silk-frame printing machine, electro-static spray painting, and a gas-heated oven.

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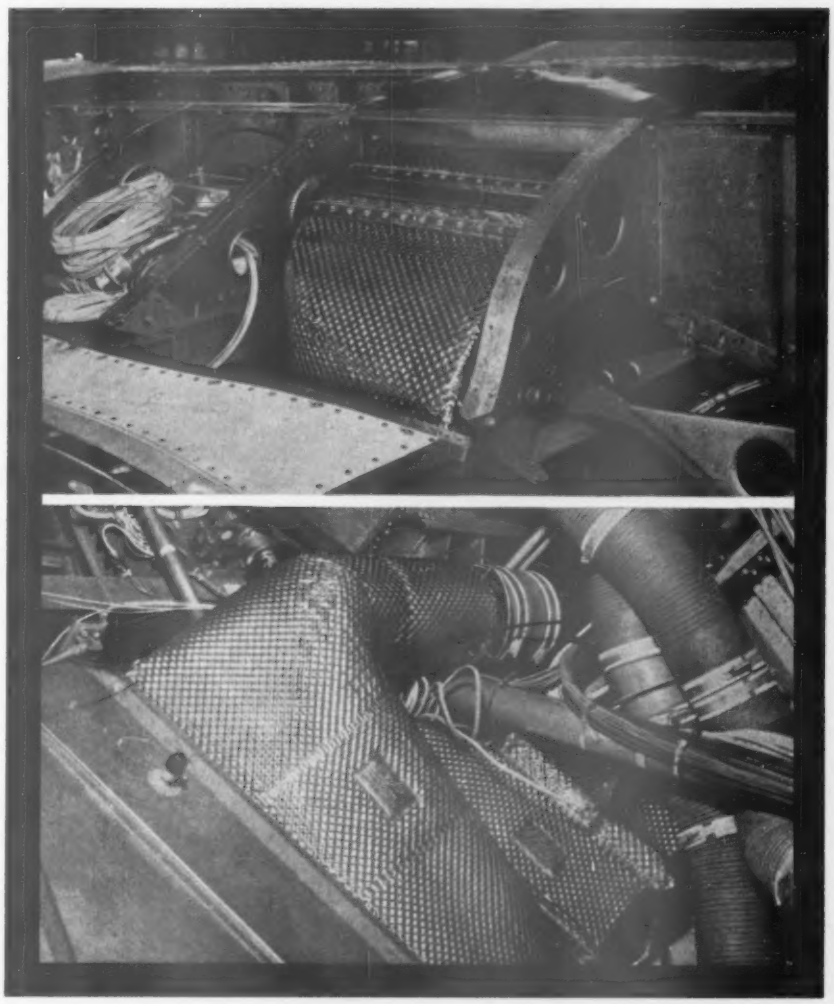

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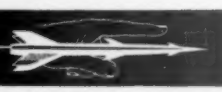


Thor and V-Bomber

—*Balancing the Strategic Force*

DEVELOPED over the past few years, the British deterrent philosophy has one main object—to be capable of nuclear retaliation in the event of an attack on these islands. For this task the United Kingdom must possess an independent deterrent force which is not open to complete destruction on the ground.

To meet this defence policy there are four main R.A.F. formations. These comprise the V-bomber force under national control; the Valiants and Canberras committed to SACEUR; the Bomber Command strategic reconnaissance force comprising Victors, Valiants and Canberras; and the new missile force consisting of Thor IRBMs under Anglo-American control.

The national deterrent formations come under the operational control of Bomber Command, which is in itself divided into two Groups—No. 1, equipped with Vulcans and Canberras and No. 3, operating Valiants and Victors. No. 3 Group is also responsible for the strategic reconnaissance force with the Thor missile bases divided between the two Groups.

Altogether there is a total of 22,000 officers and other ranks in the Command, of which the V-bombers have 9,500 and by far the highest proportion of officers. The missile force will have a total of approximately 4,000 when it is complete; and the reconnaissance squadrons have a total strength of approximately 1,500 officers and men.

Of these forces, the V-bombers with their self-contained navigation-radar systems are at present capable of delivering mines, H.E., and nuclear free-falling weapons; air-to-ground nuclear missiles in the form of Blue Steel are coming along in the not-too-distant future. The bombers' range has been greatly extended by air-to-air refuelling and Valiant training flights have been made to Cape Town in 12 hr. with two refuelling operations. Vulcans, on the other hand, can fly non-stop from the United Kingdom to Darwin in 16 hr., with three flight refuelling contacts en route.

The Canberra force can deliver H.E. and nuclear weapons at both high and low altitude. In the reconnaissance rôle, P.R. V-bombers are capable of photographic or radar mapping, with the accent on the latter technique which is not affected by light or weather conditions. In a single 5 hr. sortie over Russia from the U.K. a Victor B.2 would be able to accomplish radar-reconnaissance of a large area extending as far as the Caspian Sea.

Now co-ordinated with the bomber force, the Bomber Command Thors are being deployed at four bases along the east coast of England. Each base, or complex, comprises five squadrons located at the main unit and four surrounding satellites. There are three Thor launching pads to a squadron, so that each complex has 15 missiles under its control.

At present, three of the bases are classified as operational and when the fourth reaches this status, by the middle of this year, there will be a total of 20 R.A.F. strategic missile squadrons and 60 operational Thors. There are no operational reserves in this country as the Service does not plan for a second firing from its U.K. sites in the event of a nuclear war.

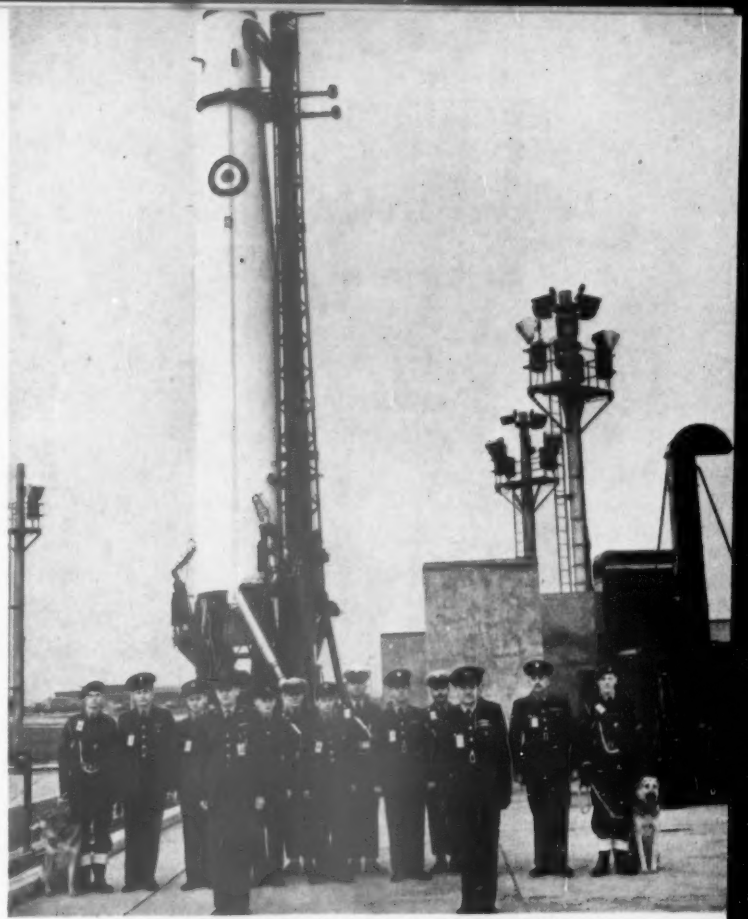
This policy has been qualified by the C.-in-C., Bomber Command, Air Marshal Sir Kenneth Cross, who has stated that, so far as Thors are concerned, "The object of the exercise is never to fire them." Obviously, once this happens they will have failed as a deterrent.

The first three Thor bases were classified as operational weapons systems by Bomber Command two months ago. This position has been reached within two years of the signing of the agreement between the United States and British Governments in February, 1958, and only four years after the United States started development work on the missile system at the end of 1955.

Altogether, a total of 80 Thors have been launched in the United States to date, of which R.A.F. crews have fired 11. Of these, nine were completely successful, one was partially successful and one was a failure. The first R.A.F. Thor firing—by a launch-control team from the third strategic missile squadron to be formed—was made on April 16, 1958, at Vandenberg A.F.B. in California.

All the Thor sites are old airfields and the first to be developed as a missile base was R.A.F. Feltwell: it was transferred from Flying Training Command to Bomber Command for this purpose in May, 1958. A crash construction programme was started at once and by August the first launch pad was completed and handed over to Douglas Aircraft Co., the principal contractor. Feltwell was finished and checked out in June, 1959, and the third base was completed in January of this year.

The 15 missiles and their extensive range of ground equipment at Feltwell cost £17 million, which was borne by the United States. Civil engineering and local civilian employment pay at the base involved a sum of approximately £3 million and the training cost of the personnel forming the five squadrons reached £3 million—adding up to an outlay of £23 million for



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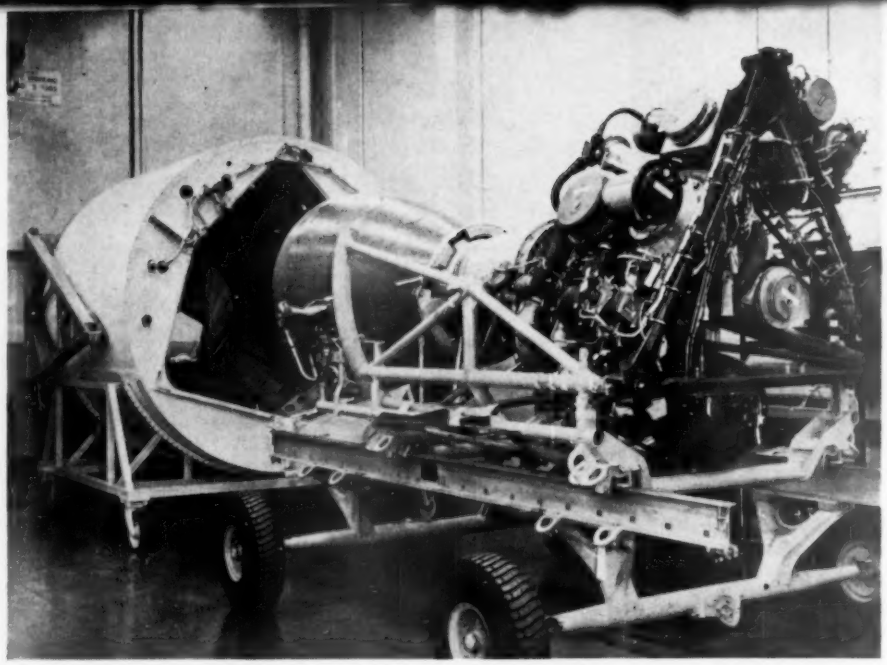
A complete launch control crew comprising the R.A.F. launch control officer (right), the U.S.A.F. authentication officer (left), maintenance personnel, guards and firemen.

A view of a squadron's launch control room from which its three Thor IRBMs are fired. On the left is the launch control officer at his console containing the automatic countdown equipment.



A complete Rocketdyne motor on a servicing trolley in the RIM (Reception, Inspection, Maintenance) building. It comprises the main propulsion and two small vernier motors for obtaining precise control under powered flight.

the complete Feltwell programme. The cost of the civil engineering work was the responsibility of the R.A.F. and the two air forces shared the training costs.

Each Thor base is manned by about 1,000 officers and men spread over the headquarters unit and the five squadrons. The organization is on conventional R.A.F. lines, with a base commander, who is a Group Captain, and three Wing Commanders (Operations, Technical and Administration). Operating on a 24-hour day, seven days a week, system, each squadron has five launch-control crews.

Comprising an R.A.F. launch control officer, a U.S.A.F. "authentication" officer and five technicians, each launch-control crew is capable of firing the squadron's three missiles. The U.S.A.F. element at Feltwell consists of 36 officers and 50 N.C.O.s who are responsible for firing, repair and maintenance of the re-entry vehicle and warhead.

The Weapon System

Described in technical detail in previous issues of THE AEROPLANE AND ASTRONAUTICS (notably that for April 24, 1959), Thor, in brief terms, is a single stage IRBM with a launching weight of 110,000 lb. In a matter of some 15 minutes it can take a nuclear warhead in the megaton range over a distance of 1,500 nautical miles. It is propelled by a 150,000-lb. thrust Rocketdyne rocket motor whose propellents are liquid oxygen and a low-aromatic kerosene.

It has an AC Spark Plug inertial navigation system which controls the autopilot from the end of the 1¼-minute controlled flight programme until the two small vernier motors cut approximately three minutes after the lift-off or launch. The nose cone, containing the warhead, is then separated from the missile—the height and speed at which this occurs being governed by the range of the target from the launching point. It is also armed during this phase.

Target selection can be changed during the launching "count-down," but the missile cannot be redirected from one target to another after launching. It cannot be command-destroyed in the air or recalled after launching and is unable to give information as to the damage it causes to a target.

The ground-service equipment associated with the missile is a vital part of the weapon system. It includes a series of trailers which deal with launch control, power distribution, electrical systems, check-out and hydro-pneumatic equipment.

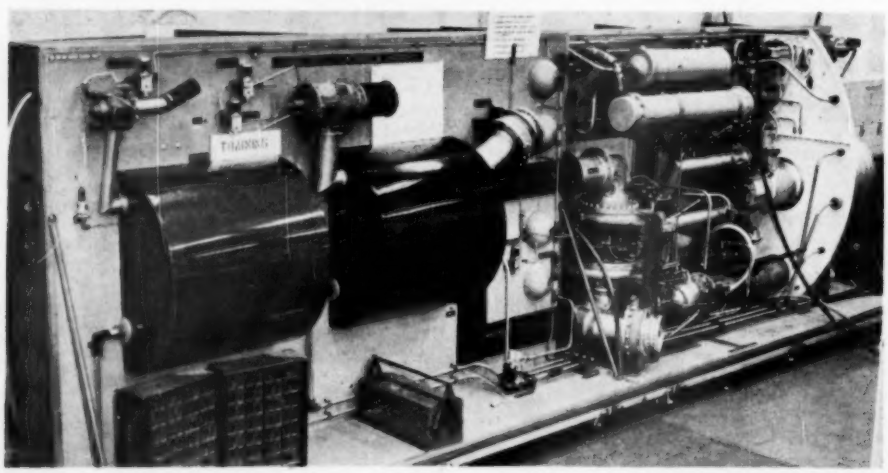
In point of fact, the periodic maintenance inspections of the complete weapon system are said to be more complex than those for a Canberra, but less involved than in the case of a Valiant. Spares requirements are similar in volume to those for a Valiant.

With all its associated ground equipment the missile can be maintained in a fully serviceable state at all times so that it can be launched within the operational requirement period of 15 minutes of an order being given. This, of course, presupposes that the nose-cone and warhead are already fitted —an operation which takes several hours. There are dummy and real warheads in this country, but the Service will never state which is which or how many missiles are fitted with real warheads at any particular moment.

The 15-minute count-down period prior to the launch is automatic and consists of five phases. The missile is normally kept in the horizontal position under its protective shelter and during Phase One the power supplies are switched on and the missile is automatically checked out. After approximately 4½ minutes Phase Two starts, the protective shelter moves back and the missile is raised by its erector trolley to the vertical position.

Phase Three starts the fuelling operation and the erector trolley is lowered during the fourth phase. The final phase controls the start of the motors and the build-up of thrust for the lift-off.

The count-down process can be stopped, and held, at any period up to approximately three seconds from the lift-off. And firing of the missile can be stopped right up to the moment of lift-off.—P.R.R.



A half size simulated Rocketdyne motor in the RIM building at Feltwell. The rig is used for training servicing crews.

Soviet Space Research Discussed

INTRODUCED by Mr. Patrick Moore, F.R.A.S., the B.B.C.'s "Sky at Night" astronomer, Prof. Alla G. Masevich gave an expert survey of the Soviet artificial satellites and Lunik probes, outlining the way these vehicles were helping to gather information, much hitherto unsuspected, about conditions in near space and between the Earth and Moon. She lectured twice in London, first on February 6 at the Royal Festival Hall and then to the B.I.S. on February 10.

Dealing with the influence of air drag on the satellite orbit, she paid high tribute to the R.A.E. tracking teams by including among her slides a graph prepared by Dr. King-Hele based on observations of the three Soviet satellites, two rocket carriers, and the U.S. satellites. Dr. King-Hele, she said, had done excellent work in reducing all available data on the satellites, which had led to a much clearer understanding of the density of the upper atmosphere.

There were basically four methods of obtaining information on air density: (1) air drag measurements; (2) measurements of the propagation of radio waves and calculation of the density of the electrons; (3) direct measure of atmospheric pressure by manometers—such an instrument was carried in Sputnik III—and (4) observation of the evolution of sodium clouds—such experiments had been made with rockets at heights of 260-270 miles.

All these results, particularly from (1) and (2), had shown excellent agreement.

Prior to the use of artificial satellites, our understanding, Prof. Masevich said, of conditions up to altitudes of 90 miles or so was very poor and above 180 miles practically nothing was known. With the aid of the Sputniks, air density had been found to be five to ten times higher than had been suggested by sounding rockets. This was largely accounted for by temperature variations in the upper atmosphere, differences in latitude between various soundings, the seasons, and night and day.

In addition, the influence of the Sun on the Earth's upper atmosphere had been found to be much greater than was previously supposed. It had now been realized, for example, how greatly the atmospheric temperature—and hence its density—was affected by sunspots and solar flares. This had the greatest importance for meteorology.

The lecturer showed a graph in which the onset of a solar flare and subsequent distortion of the Earth's magnetic field and atmospheric density was plotted against time in days. This clearly showed that approximately 1½ days after the appearance of the flare on the Sun, the character of the magnetic field changed for a period of days. Almost at the same time, there was a change in the temperature of the atmosphere and, consequently, in its density. This was not due to an increase of ultra-violet radiation but to corpuscular radiation emitted from the region of the solar flare.

Of Sputnik III, the "orbital laboratory," the lecturer said the radio transmitter had been working reliably since it was launched nearly two years ago, as had that of the American Vanguard I. This was thanks to solar batteries which, at first, were thought would have been impaired by micrometeorite erosion. Meteors were not now considered a great hazard to space-flight.

Lunar Photography

Nevertheless, in dealing with Lunik III, the Soviet probe which photographed the Moon, Prof. Masevich recalled that the radio contact had ceased abruptly some time after the photographs were transmitted and this failure had been attributed to meteorite damage. The U.S. Explorer III had apparently suffered a similar fate.

On the subject of the Moon pictures, Prof. Masevich said that to obtain the best results several photographs of the same areas of the Moon had been superimposed.

Questioned on the likelihood of a Russian entering space in the near future, the lecturer said that in her country at least this would only happen after the re-entry problem had been completely solved—"when we can ensure not only a ticket to the Moon but also a return ticket," she added amidst laughter.

On the effects of the radiation belt, a good way of dealing with the problem was to avoid it by launching from the Polar regions.

Of the next steps to be expected in the Soviet Union, she said there would undoubtedly be more geophysical experiments with Sputniks, and further probe vehicles would be sent to the Moon—and also to the Planets.

Interesting ciné shots were shown of the Earth's cloud-cover obtained from Soviet geophysical rockets, and from all that was shown on the subject of rocket-meteorology, it would not be surprising if one of the next Sputniks did not carry television equipment for the purpose of extending these investigations.

As Vice-President of the Astronomical Council of the U.S.S.R. Academy of Sciences, Prof. Masevich had played a leading part in organizing Moonwatch tracking teams in Russia. The Astronomical Council had originally planned to have 70 Moonwatch stations spaced approximately 600 miles apart and equipped with 30 Moonwatch telescopes. However, such was the enthusiasm for this work after the first Sputnik was launched that many more optical tracking stations were established—actually more than were really needed.

The simple Moonwatch telescope with mirror reflector, Prof. Masevich said, had been joined by another instrument which combined both the principles of the theodolite and the Moonwatch telescope. This had a large field of view and, moreover, was movable and could be used to search for satellites of up to 8th stellar magnitude.

Moonwatch Camera Equipment

More precise observations required the use of cameras, and an aerial camera had been modified for this purpose and amateurs trained in its use. It also has a wide field of view (30 to 50 degrees) and was fitted with an automatic shutter with a speed of about 1/2,000th sec.; this was operated in conjunction with a chronograph or, if the station was sufficiently near, it was linked with the timing system of an astronomical observatory.

Prof. Masevich devoted the remainder of her lecture to the Lunik probes and the celebrated Moon photographs obtained with Lunik III.

She showed a picture of the sodium cloud released by Lunik II on its way to the Moon and said that this had been done for no other purpose than to mark the position of the rocket in case the tracking transmitter had failed.

After the instrument container had hit the Moon, letters had been received by the U.S.S.R. Academy of Sciences from observers in the Soviet Union, Britain, Sweden, Hungary and Poland, who claimed to have observed the vehicle's arrival on the lunar surface. Some observers had described a bright spot and others a dark spot, and descriptions of the point of observation ranged over a wide area.

All these sightings were carefully analysed by Soviet astronomers. Although differences in intensity of the observed "spot" could be explained by, on the one hand, a cloud of dust raised by the impact, which might appear "bright," and the projection of this cloud as a shadow, which might appear "dark," it was really unlikely that such could have been observed. It was reluctantly concluded that even if all the kinetic energy of the impact went into raising the dust cloud, it was doubtful if this would have been seen from Earth.

On the technique of lunar photography used in Lunik III, the reason why the pictures of the hidden side of the Moon were taken when it was fully illuminated by the Sun was that it was easier for a photocell, which played an essential rôle in orientating the camera-end of the probe on to the Moon, to lock-on the Sun in the opposite direction.

The television system used in transmitting the pictures to Earth had an output of only a few watts and, as a result, the transmission was 10,000 times slower than in conventional television. Thus, it took a long time to get one photograph and all the time there was anxiety lest some small fault should develop in the probe's equipment.

The 35-mm. negatives were scanned by a small scanning tube in the same way as films are televised by TV stations, so that each part of the negative was converted to electronic signals and reconverted to light signals at the Earth-end of the radio link. The number of scanning lines used in building up the picture was variable, with a maximum of 1,000 lines per frame of film.

A further point made by Prof. Masevich was that had the probe not been damaged by a meteor, a second set of photographs could have been obtained when the probe was much nearer the Earth—perhaps from 5,590 miles instead of 248,400 miles as actually occurred. This would have produced pictures of higher definition.

In conclusion, she made a strong plea for international co-operation in space-research. Observations of satellites cannot be carried out properly without the co-operation of other countries and other scientists.

Professional astronomers and amateur observers from all over the World had sent in their results, which was a good sign that this work would bring scientists throughout the World together and, she hoped, not only the scientists.

On the Launching Pad

AFTER a lapse of over two months in the U.S. satellite launching programme, Cape Canaveral, Vandenberg and Wallops Island are being prepared for a new round of activity. Several of the scheduled firings are concerned with projects which may have future commercial and defence significance.

First, a series of new attempts will be made to effect recovery of 300-lb. re-entry capsules from the Discoverer-Agena satellites. This programme is considered vital in the development of the Mercury space-capsule, and is also concerned with the Samos reconnaissance satellite. The first firing of the New Year was, in fact, that of Discoverer IX on February 4, which unfortunately did not go into orbit.

Next month we may expect to see another attempt to orbit the ARPA-U.S. Navy Transit navigational satellite. The first attempt on September 17 last year failed when the final stage of the Thor-Able launching vehicle apparently refused to ignite.

The 36-in.-diameter satellite weighs 265 lb. and has three transmitters operating on frequencies of 54 mc/s., 162 mc/s. and 216 mc/s., all at 100 mw. A broad-band spiral antenna is painted on the outside of the glass-fibre shell. Power supplies consist of two silver-zinc and two nickel-cadmium chemical batteries, the latter being recharged by solar cells.

Object of the satellite is to test the feasibility of an all-weather navigational system for ships and aircraft, with special reference to the operation of air- and underwater-launched ballistic missiles.

By the time the system is fully developed in 1962-63, it is hoped that the Transit satellite will give Polaris-equipped submarines a positional "fix" accurate to within 1/10 of a mile. This will require special seaborne receiving equipment, but the U.S. Navy have suggested that ordinary shipping without such equipment should be able to obtain a "fix" accurate to within half a mile.

In March or April, the first of three 100-ft.-diameter inflatable satellites is expected to be launched for experiments in radio communication, using "passive" radio-wave reflection techniques. Launching vehicle will be the newly developed Thor-Delta rocket.

This spring may also see the launching of the U.S. Navy-NASA Tiros, a meteorological satellite designed to obtain pictures of the Earth's cloud cover by television methods. Camera equipment for this project has been developed by the Radio Corporation of America in collaboration with the Army Signal Corps.

In the late spring is scheduled the first launching of the ARPA-U.S. Army Courier communication satellite, a delayed repeater regarded as the first step in establishing global communications. The Army Signal Corps have developed a teletype system to handle 20 continuously available 100-word-per-minute teletype channels.

The first attempt to orbit the ARPA-U.S. Air Force Samos reconnaissance satellite is expected in midsummer. This project, originally named Sentry, is in the hands of Lockheed and is intimately related to the Discoverer-Agena programme which has already proved the stabilization technique.

The Midas early-warning satellite is also scheduled for launching this summer. This again is a Lockheed project, but concerned with the early detection of ICBM launchings by infra-red radiation.

Launchings of the four-stage Chance Vought Scout—the vehicle that Britain will use in a co-operative satellite programme with the United States beginning in late 1961—are also expected this summer, with the possibility of a three-stage test version being fired possibly within the next two months. The launching tower has now been installed at Wallops Island and finishing touches are being made to the block-house and other support facilities.

Blue Streak Prospects

QUESTIONED about the future of Blue Streak, in a possible British space-research programme, in the Commons on Feb. 8, Mr. Duncan Sandys assured the House that development of the missile would continue.

CAPT. G. R. CHETWYND (Lab., Stockton-on-Tees) asked what contribution was made by the Ministry of Aviation towards the cost of space research. Mr. Sandys replied that the Ministry was proceeding with design and modifications to make it possible for the British rockets now under development for military purposes to be used for the launching of space satellites. A number of other related projects were also being studied. This work was being done partly by the Royal Aircraft Establishment at Farnborough and partly by industry.

MR. WOODROW WYATT (Lab., Bosworth) asked if the Minister would give an assurance that there is no danger of Blue Streak being cancelled—as was thought by many people not far from Government circles—as the whole possibility of our taking part in a research programme depends on the Government going ahead with Blue Streak.

Mr. Sandys considered such to be rather dangerous thoughts, but, pressed by Mr. Wyatt, added: "I know of no intention to discontinue the development of Blue Streak."

Mercury Ground Tracking

AN extensive network of tracking stations is being established in readiness for the Mercury space-capsule programme which is expected to put a man into orbit next year. Prime contractor in the tracking programme is Western Electric who have recently secured a contract for $30 million to provide the necessary equipment. Associated with this company on the project are Bell Telephone Laboratories, Inc., Bendix Aviation Corp., and Burns and Roe, Inc.

Eighteen sites will constitute the World-wide chain of ground stations, construction of which has already begun. For the past six months, hundreds of scientific and engineering personnel from various companies have been working on such diverse tasks as designing new radar and telemetry equipment, establishing base camps for siting locations in many isolated areas, and experimenting with new and different types of electronic equipment.

The World-wide network essential to the success of the project, and the safety of the man in orbit, will have a computing and communications centre at the Goddard Space Flight Center, Beltsville, Maryland, and a control centre at Cape Canaveral.

The 18 stations comprising the full surface tracking facilities will include Cape Canaveral; Grand Bahama Island; Grand Turk Island, Bermuda; specially equipped radar picket ships in the Atlantic and Indian oceans; the Canary Islands; two sites in Africa; West and South Australia; Canton Island; Hawaii; two sites on the U.S. West Coast; White Sands, New Mexico; South Texas, and Elgin Air Force Base, Florida.

New Giant Radio-telescope

THANKS to the foresight of Manchester University and Prof. A. C. B. Lovell in particular, Britain has taken a pioneer rôle in the field of radio-physics and space-radar. Our lead, of course, is largely connected with the Jodrell Bank radio-telescope which had not only been effective, as an instrument of radio-astronomy, in probing the far depths of galactic space but by enabling this country to track satellites and space-probes has put it in the forefront of such activities.

Our lead in big directional radio-telescopes is not to last, as a U.S. Navy instrument of even more formidable dimensions is being erected. Whereas the Jodrell Bank reflector "bowl" measures nearly 250 ft. across, that of the American radio-telescope will be no less than 600 ft. The aluminium-mesh reflector will have an area exceeding seven acres and the whole instrument, complete with its mounting and base supports, will weigh nearly 20,000 tons.

The site of this giant instrument is the isolated hamlet of Sugar Grove, near Greenbank, West Virginia, and a law has been passed which prohibits any man-made electrical interference—including cars—within two miles.

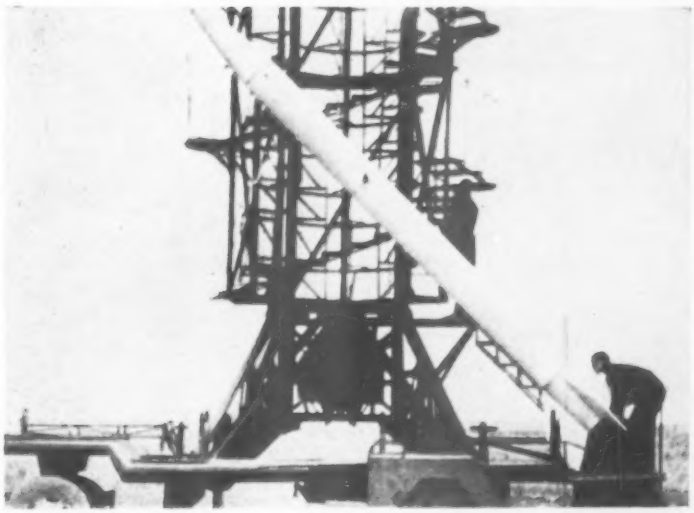
The U.S. Navy state that their radio-telescope will have more than twice the range of Jodrell Bank and will permit the

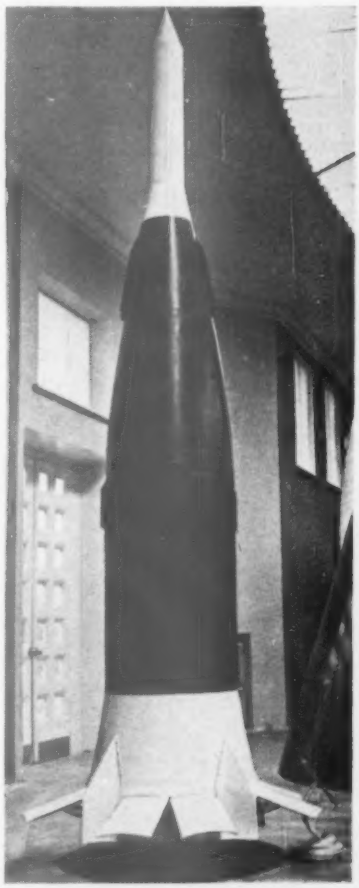
reception of radio signals emitted by galaxies at distances as great as 250,000 million million million miles. From these radio emissions, scientists hope to deduce the number, size and concentration of galaxies up to 20 times the range of the largest optical telescope on Mt. Palomar. One of the big "unknowns" that this instrument may help to solve is whether or not there is any thinning-out of the Universe at these enormous distances.

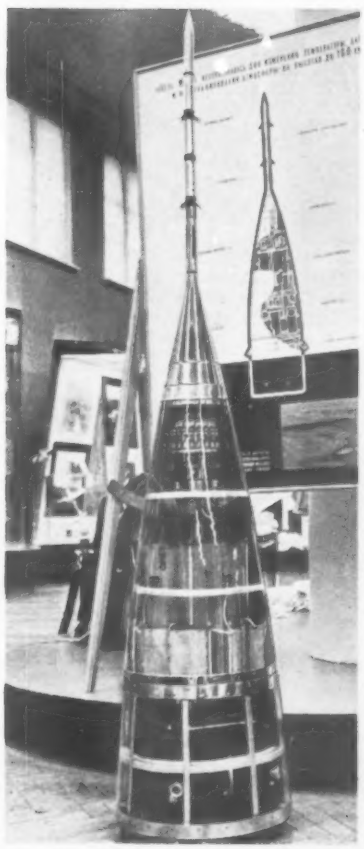
When the giant Sugar Grove instrument is completed in 1962, no doubt it will play a part with Jodrell Bank in the tracking of robot probes navigating the "in-shore" of our own Solar System.

Rocketry in the U.S.S.R.

Progress illustrated by PROF. ALLA MASEVICH







Above, a Soviet meteorological rocket is placed in the launching tower; both the nose-cone and rocket body are recovered by parachutes.

Right, the instrument container of a single-stage A-3 geophysical rocket similar to that launched on Feb. 21, 1958, which reached an altitude of 294 miles with a payload of 3,350 lb.

Left, the instrument container of the Russian MR-1 sounding rocket used to measure atmospheric density and pressure.

Below, a camera at Pulkovo Observatory used to photograph the sodium cloud ejected from Lunik II as a tracking "marker."

Flying the STOL Broussard

by John Fricker

Photograph copyright "The Aeroplane and Astronautics"

FOR me, 1959 was a vintage year. It brought 32 types of aircraft to fly, and the best weather I can remember as a pilot in which to try them. This was not altogether true of the latter part of the year, but fortunately the deteriorating conditions coincided with a veritable spate of short take-off and landing aeroplanes.

These were the least demanding of anything except helicopters for good weather, but at the same time offered some interesting flying techniques. They included the Czech Brigadyr, the Canadian Otter and Caribou, the Swiss Porter and the French Broussard. Products, in fact, of four different countries, but with the common aim of short take-off and landing, achieved largely by common means, and having surprisingly similar handling.

Although these types are generally acknowledged as STOL aeroplanes, nobody has yet laid down with authority what performance merits such a description. In the United States, NASA applies the STOL appelation to any fixed-wing type capable of operating from a 500-ft. strip surrounded by 50-ft. obstacles. This is sufficiently drastic, however, to eliminate all but a handful of experimental aircraft, which may more accurately be described as V-STOL (very short take-off, etc.) types.

Most of the aircraft currently in commercial and military service on short field operations require about twice this distance, but by normal standards, even as much as 400 yd. for take-off and landing over 50 ft. must be regarded as STOL performance. As the French representative in this category, the Max Holste M.H.1521 Broussard compares fairly closely with the D.H.C. Beaver. It is similarly powered with the 450 b.h.p. Pratt & Whitney R-985-AN-1 Wasp Junior engine, but has been produced primarily for service in tropical climates instead of the Arctic bush. More than 400 Broussards have been ordered, and well over half this total have been delivered. Production is continuing at the rate of six aircraft per month, and is due for completion early in 1962.

The Broussard ("Bushman") is the first aircraft to be built in quantity by Avions Max Holste. The prototype M.H. 152, which was powered by a 220 b.h.p. Salmson engine and first flew on June 12, 1951, was intended for light transport and A.O.P. duties, and its development coincided with the growth of the Algerian war. Re-engined with the Wasp Junior, the M.H. 1521 made its initial flight on November 17, 1952, and 32 pre-production aircraft were initially ordered for Algerian service.

Although employed exclusively on Army liaison duties, including casualty evacuation, reconnaissance and command post flights, the Broussard is operated by the French Air Force, which ordered 385 aircraft. The Army has only a couple of dozen Broussards, and three have gone to *l'Aeronavale*, the Naval Air Service. The French civil aviation authorities have the prototype Broussard and another example for general duties, and a further 50 or so have been sold to civil operators in places as far removed as South America and Cambodia.

The Broussard entered service in Algeria in May, 1956, with *l'Escadrille de Liaisons Operationnelles* 3/45, which was the first French Air Force unit to receive the type. Its first casualty evacuation flight took place in June, to be followed by very many others, and it also began the command post, or "mosquito" type sorties in August. In the latter missions, the Broussards seek out rebel bands during low altitude reconnaissance, and mark their location with underwing rockets or smoke grenades, before calling in fighter-bombers or artillery by radio.

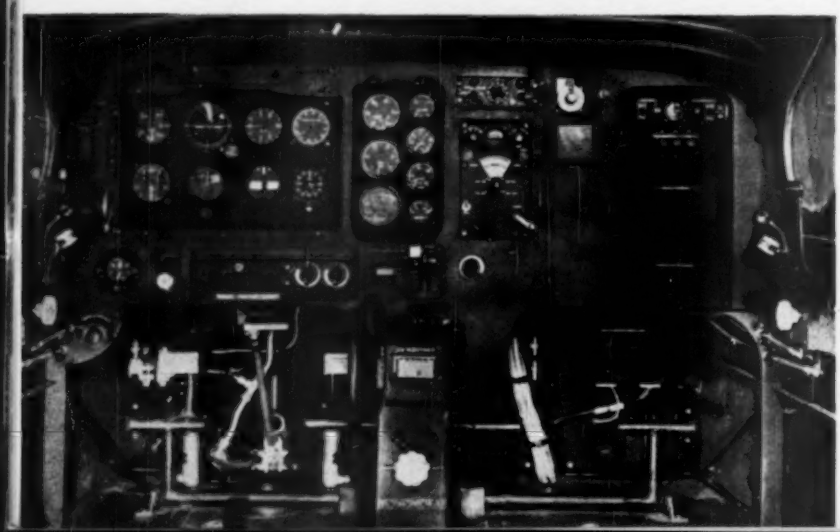
Understandably, the Broussards are not greatly liked by the F.L.N., and they are subjected to intense and quite accurate small arms fire. It says much for the sturdiness of their structure that their losses have been fairly low, although it was found necessary to add small self-sealing fuel tanks to supplement the normal wing-root tanks and provide a safety margin to get clear of rebel areas. Total fuel capacity is now 96.8 Imp. gal.

Construction of the Broussard is all metal, with fabric-covered control surfaces and flaps. The large-area ailerons and flaps are both slotted and are attached to the rear spar of the NACA 4413 high-lift wing. The ailerons are arranged to droop 13° when the flaps are lowered to 45°. One version of the Broussard, the M.H.1522, was produced with double-slotted flaps and ailerons and full-span leading-edge slats, but the gain in low-speed performance was not usuable without additional design complication.

In the Avions Max Holste factory at Rheims are built the wings and tail unit of the Broussard, the fuselages arriving from S.I.P.A. in Paris for furnishing and assembly. A high quality of workmanship is displayed in the airframe, which is also very soundly engineered. In the fuselage is a commodious (170 cu. ft.) cabin with a length of 10.2 ft., a maximum width of 4.1 ft. and a mean height of 4.3 ft. Double entrance doors on the port side provide a freight opening of 3.78 by 4.2 ft., the forward section being hinged and the aft sliding rearwards. The forward door may be removed to facilitate air dropping.

For passenger carriage, the Broussard seats six, including the pilot, but the rear four seats may be rapidly removed and the space used for freight, radio equipment, cameras or two stretchers, with attendants. Maximum payload is well over half a ton, so that a spare Wasp Junior engine or any similarly bulky load may easily be carried. In its agricultural form, the Broussard has a 176-gal. chemical tank in the cabin and a maximum payload of 2,000 lb.

(*Continued on page 235*)



"... the instrument layout on the deep front panel ... is one of the most businesslike I have encountered." In this photograph, both control columns have been removed.

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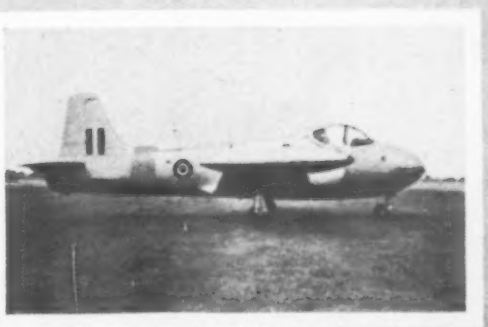

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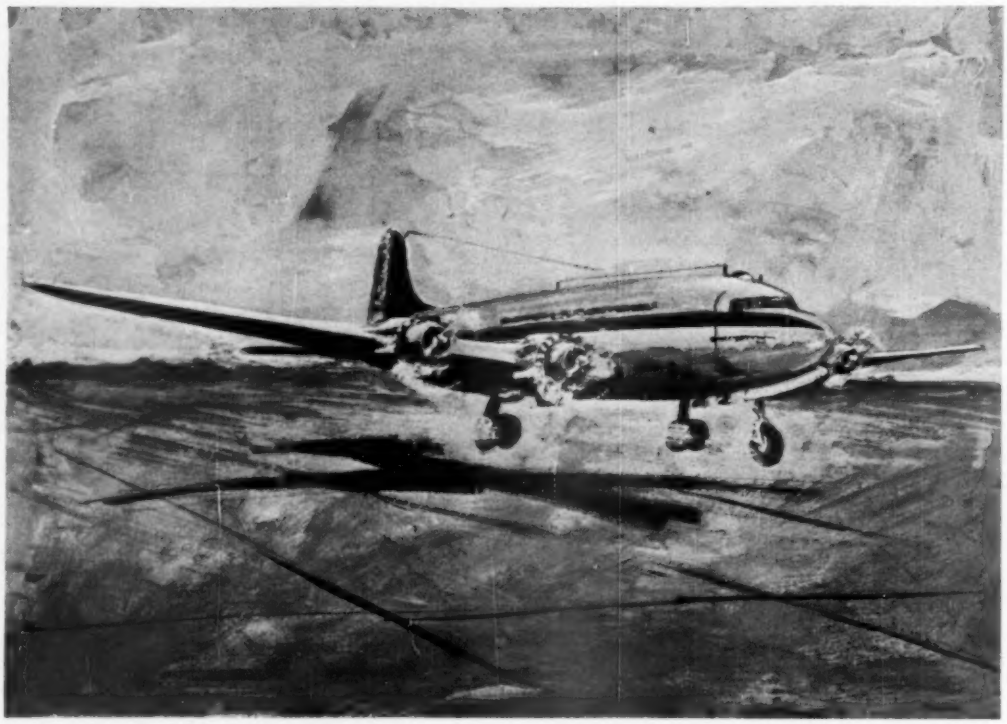

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(*Continued from page 234*)

Although the Broussard powerplant has long been out of production, it is still widely available, and in France is reconditioned as new by AIA of Bordeaux. The compact installation of the Wasp Junior has undergone several modifications in the Broussard during its production and in the latest military variants the engine mounting has been extended forward by seven centimetres (2¾ in.). This is to balance the very heavy load of radio carried by the command post Broussard, and at the same time the cowling has been fitted with controllable cooling gills and a revised carburetter air intake.

Location of the Cessna-type spring-steel undercarriage legs, which are each attached to the fuselage by a single bolt and are made from one piece of metal, remains unchanged. The main wheels have fat, low-pressure tyres for operation from unprepared surfaces, and disc brakes manufactured by the ERAM company, which is also responsible for the self-centring tailwheel.

My Broussard briefing came from Pierre Clostermann, the well-known French fighter ace, at the small grass airfield of Max Holste at Rheims/St. Leonard, where there is about 700 m. diagonal run. M. Clostermann has an interest in Avions Max Holste, and has flown Broussards operationally in Algeria as a French Air Force reservist. We were to fly his personal aircraft, F-BICX, which is a civilian version and is used by him for both business and long-range touring flights. In it, he flew back from a Broussard sales tour of Australia, and finds its short-field performance very useful for landing almost anywhere. It differs from the standard military model only in a few details of radio equipment and other minor points, and has the older-type short cowling.

On entering the roomy cabin, by means of the fixed step beneath the door, I found it a simple matter to squeeze into the left-hand seat, which, like its companion, is adjustable for height. I was immediately impressed by the instrument layout on the deep front panel, which is one of the most businesslike I have encountered. Flight and engine instruments are grouped very positively on port and centre panels, which, like the electrical panel to starboard, hinge downwards on releasing two thumbscrews, for maintenance.

Full Dual Control

Much use is made in the Broussard of vertically moving levers for operating the flaps, fuel and oil cocks, carb. heat and oil cooler controls, and even the ignition switch. Although most of these are grouped on the extreme left of the panel, there is no risk of confusion, and they are sensible and effective controls. Equally attractive are the engine control quadrants on each side of the cockpit, with throttle, pitch and mixture levers in descending order of size, and a single friction knob beneath.

Unlike its transatlantic contemporaries, the Broussard sticks to European tradition in having dual control columns instead of wheels. A stick always seems preferable to me for maximum manœuvrability. Non-adjustable dual rudder pedals are also provided, the port set having toe brakes with a parking lever, rather like an umbrella handle, in between.

The pleasing impression of the cockpit is completed by the central trim tab box, which has a large side wheel, and adjacent indicator scale, for the elevator, and a small rudder trim wheel on top. The only improvement possible with this arrangement would be to have the rudder indicator scale at the rear of its trim wheel, to work in the logical plane, instead of alongside it.

In this photograph the revised cowling of the Broussard, with its cooling gills and rearranged carburetter intake, is apparent, following the extension of the engine mounting to compensate for heavy rear cabin loads.

Photographs copyright "The Aeroplane and Astronautics."

The flights for this article were made in the personal Broussard of Pierre Clostermann, the well-known French wartime pilot, who is a consultant to Avions Max Holste.

Except for the usual high-wing penalty in turns, the Broussard pilot has a good all-round view through the violet-tinted wrap-round windscreen, with excellent oblique sliding side windows for clear vision in bad weather. The instrument panel is surmounted by a coaming, which prevents reflections on the sharply raked front screen. On the ground, the fat cowling of the Wasp is slightly obtrusive in the tail-down attitude, but the Broussard responds well to the S-turn technique when taxi-ing, with a jab of toe brake.

Ground stability is very good, with the steel landing gear legs giving a slightly stiff and springy ride. Being well set forward, they permit the harsh application of brake, and even at a forward C.G. result in a fairly tail-heavy feeling on take-off. This is a characteristic of most STOL aeroplanes, but is less apparent in the later and longer Broussards. In both variants it is partly offset before the slipstream becomes effective by the forward stick resulting from the elevator being balanced at 50% static load, but, in any case, the Broussard unsticks after a very short run in the three-point attitude.

With zero trims and 15 degrees of flap selected electrically on the scale flanking the port panel, I opened up gingerly for my first take-off in the Broussard, which was in a briskish cross-wind from port. Full throttle resulted in 129 *pièzes* (38-in.) on the manifold pressure gauge, and 2,300 r.p.m. There seemed to be no particular tendency to swing, and rudder control was apparent at a very early stage. The Broussard, in fact, unstuck with very little help from me at 50-55 knots I.A.S., and the nose had to be pulled up very steeply to keep the speed down to the recommended 80 knots. Although no particular effort was made to achieve a short take-off, the run was less than a couple of hundred yards.

For a maximum performance climb, the Wasp should be throttled back only to 123.5 Pz, but 105 Pz and 2,000 r.p.m. were sufficient with our relatively light load of two up and 430 litres (95 Imp. gal.) of fuel. Retracting the flaps with a flip of the lever switch did not result in a noticeable sink or change of trim, and the Broussard proved pleasantly stable on initial acquaintance in the air. As in other STOL aeroplanes with very large control surfaces for low-speed handling, slight snatch or buffet was evident through the ailerons and rudders at times, but this was not apparent at the upper end of the speed scale.

My first flight in the Broussard was restricted by low cloud, but on the following day I took full advantage of excellent winter weather to explore the full range of handling. Good use was also made of the first-class observation characteristics of the Broussard in ranging over the historic battlefields of the Marne, south of Rheims. We flew low and slow over the many desolate areas on the gentle hills which remain inaccessible wildernesses of shell holes and trenches, unchanged since World War I.

In cruising flight, at 90 Pz and 1,900 r.p.m., with a very moderate noise level from the slow-turning Wasp, the Broussard settled down to indicate about 110 knots, which builds up to about 120 knots T.A.S. at the rated altitude. Fuel consumption is then about 16.4 Imp. gal./hr. There had been very little

static friction in the control circuits on the ground, and in the air, the response was equally pleasant.

With their wide speed range, most STOL aeroplanes are inevitably fairly heavy on the controls in normal flight, but the Broussard seems to have found an excellent compromise for most operating conditions. This has been achieved by maintaining positivity of control at all airspeeds with an appropriate amount of stability, so that the aircraft seems to do exactly what is wanted with little personal effort, and tends to stay where it is put.

Moderate aileron and elevator forces are allied with rudders which are heavier at cruising speeds, and the Broussard is rather sensitive to directional trim. This is probably a peculiarity of a twin-finned single-engine aircraft, and some of the "heavying-up" is undoubtedly due to the "L" section strips on the rudders, which presumably prevent over-sensitivity in cruising flight. The Broussard is otherwise surprisingly unmoved by changes of power, flap setting, etc., throughout its speed range. Never exceed speed is 170 knots.

For slow-speed flight, 30 degrees of flap is recommended, and with a power setting of 85 Pz and 1,800 r.p.m., the Broussard will potter along quite comfortably at 65 knots or so. Flap limit speed is 80 knots, for extension up to the maximum of 50 degrees. At the slow-speed setting, a little elevator buffet was just discernible, and as speed was further reduced to 50 knots, a slight yaw to port began. All controls retained their effectiveness until a breakaway occurred at about 45 knots I.A.S. (54 true), with very little warning and a straight stall.

In the clear winter sky, I tried another stall, with 20 degrees of flap and power off. With a determined pull to obtain full up elevator, the Broussard sank on even keel with its nose high in the air, indicating about 50 knots. Full flap and power produced a mild breakaway and starboard wing drop unheralded by aerodynamic or artificial warning at about 40 knots I.A.S. (47 T.A.S.). From this configuration, a simulated overshoot from a trimmed approach speed of 70 knots produced the usual moderate nose-up change of trim, as a final proof of the Broussard's general docility.

I got the general impression that the flaps of the M.H. 1521 were less powerful than on some of the STOL aeroplanes tried, but they were certainly effective enough during the several landings made at Rheims. These were approached with more than usual care, since I was not sure of the reaction to be expected from an undamped spring-steel undercarriage on a relatively heavy (2½-ton) aeroplane. I learnt afterwards that it is a popular pastime among the Max Holste personnel, to watch pilots making their initial acquaintance with the spring-steel gear, but I was fortunate enough to be presented with uneventful three-pointers.

Any Auster pilot would have no difficulty with the Broussard, the same trick of achieving absolutely full aft stick (and holding it) just before touch-down ensuring a bounce-free landing. In the circuit, mixture is returned to auto-rich, flap lowered 30 degrees below 80 knots, and fine pitch selected. I used power to maintain 70 knots until finals, when full flap was lowered and the Broussard glided in at about 65 knots. There was then an adequately brief float before touch-down at 50 knots or so.

The slight cross-wind presented no difficulty at all, and with the use of brake, the landing run was no more than about 200 yd. With experience of the aircraft, this can naturally be greatly reduced. I half-expected some deterioration in directional control, because of the twin tail, on removing power at low speed, but this was certainly not apparent.

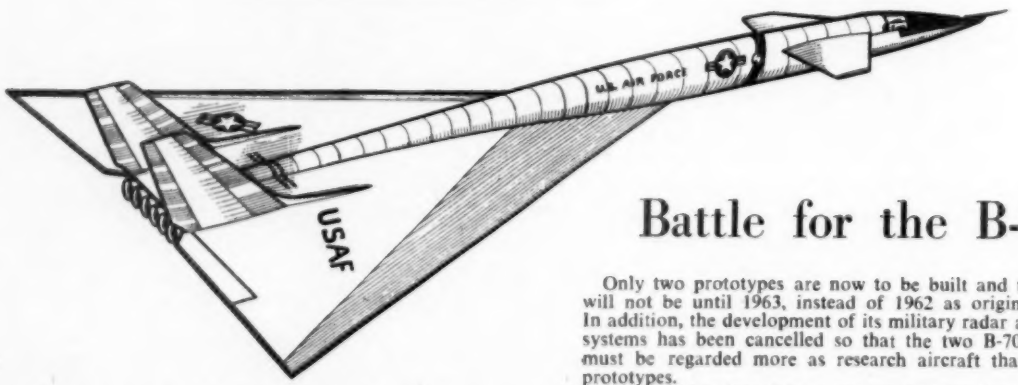
In fact, nothing really marred my enjoyment when flying the Broussard, which I shall remember for its solidity, sensibility, tractability and docility. Its versatility is equally evident, and at about $40,000, ex-factory, with full tanks and HF, VHF and ADF, its initial cost is most reasonable.

Leading Particulars

DIMENSIONS: Span, 45 ft.; length, 28.2 ft.; height, 9 ft. 2 in.; wing area, 273.4 sq. ft.

WEIGHTS: Empty, equipped, 3,373 lb.; radio, 55 lb.; passenger seats, 121 lb.; fuel (92 Imp. gal.), 661 lb.; oil, 44 lb.; pilot, 165.3 lb.; passengers, 826.7 lb.; baggage, 265 lb.; max. gross, 5,511 lb.; agricultural gross, 5,953 lb.

PERFORMANCE: Max. continuous speed, 146 knots (168 m.p.h.); max. cruise, 132 knots (152 m.p.h.); economical cruise, 121 knots (136 m.p.h.); initial climb, 1,082 ft./min.; service ceiling, 18,045 ft.; take-off run to 50 ft., 1,065 ft.; landing run from 50 ft., 787 ft.; range, 745 miles.



Battle for the B-70

AN official artist's impression of the North American B-70 Valkyrie bomber has been released by the U.S. Department of Defence in Washington. This shows that earlier unofficial drawings of this Mach-3 bomber were correct in most respects, although they suggested that the delta wing was not as highly swept as it is in fact.

The background to the development of this significant aircraft was described in our issue of October 30, 1959. Designed to replace the B-52 long-range bombers of the U.S. Strategic Air Command, the B-70 will weigh about 500,000 lb. It is to be powered by six General Electric J93-3 turbojets.

Capable of carrying air-launched ballistic missiles and the largest nuclear weapons, the B-70 has been designed to operate from existing B-52 bases. According to a U.S. report its speed will be more than 2,000 m.p.h., its ceiling 80,000 ft. and its unrefuelled range 8,000 miles.

Although regarded as a vital project by the U.S.A.F., the £350 million development programme of the B-70 received a setback last December and it now seems unlikely that this revolutionary aircraft will ever enter operational service. As a result of financial cutbacks, it was announced in Washington on December 1 that the bomber was being "reoriented to a prototype programme following a final review of weapons programmes under the 1961 defence budget."

Only two prototypes are now to be built and the first flight will not be until 1963, instead of 1962 as originally planned. In addition, the development of its military radar and electronic systems has been cancelled so that the two B-70s to be built must be regarded more as research aircraft than as military prototypes.

This decision has civil as well as military implications; U.S. development of Mach-3 airliners stands to gain a great deal from design and flight experience with the B-70.

The U.S.A.F. has not accepted the B-70 cut-back with equanimity; a powerful campaign is being waged to revive its development as an operation bomber. It is argued that the cutback is a false economy; in the financial year 1961 the saving will only be $85 million, about 0.02% of total defence spending. The decision means that Strategic Air Command will not have any supersonic bombers—apart from the supersonic-dash B-58—to succeed its current subsonic fleet.

In the U.S.A.F. view the Valkyrie decision means the end of the mixed-force concept, in which missiles and manned aircraft form an integrated deterrent system. If the U.S. is forced to rely on missiles alone, its deterrent will become dangerously inflexible. Missiles cannot report on the damage they cause, or attack targets whose position is not known in advance. Also, once launched they cannot be recalled.

The B-70 could be used, the U.S.A.F. claims, as a supersonic transport, as a recoverable booster for space projects such as Dyna-Soar, as a ballistic-missile launcher, and as a supersonic nuclear-powered aircraft. It is even suggested that it could act as a space interceptor to examine foreign satellites in orbit. Clearly, the U.S.A.F. is exploring every possible means to bring the B-70 back to life as an operational aircraft.

Personal Flying

EVERY so often, one reads about one of the myriad private pilots in the United States getting into trouble in difficult weather conditions, and overstressing his aircraft in attempting to regain straight and level flight. With the highly efficient and "slippery" light aircraft produced in their thousands across the Atlantic, acceleration downhill is very rapid, and any loss of control is likely to be accompanied by high g forces with inexperienced disorientated pilots.

Normal flight load factors are +3.5 and −1.5g, and with a representative elevator force gradient of, say, 10 lb. per g, can easily be exceeded with a one-handed pull. Even large control deflections past the maximum manœuvre speed, which is usually well below the normal cruise, can lead to trouble in turbulent air, although most aircraft have substantial safety margins.

It may not be practical from the structural point of view to increase the load factors without running into weight and performance penalties, although types like the 9.4g Italian Falco prove otherwise, but there does seem to be a case to consider the installation of air brakes on some of the cleaner designs. Sailplane practice has shown that such devices can be incorporated for very small penalties in weight and complication, and although they would have to deal with much higher speeds in powered light aircraft, they would appear to offer an invaluable safety factor for emergency use.

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This week's news from the clubs include the following:—

● The Channel Islands Aero Club is planning its liberation air rally this year for May 13-15. It is hoped that Lord Brabazon will be guest of honour. During 1959, the club flew 597½ hours, and four members gained P.P.L.s, bringing the club total to 19. The club's two Austers are fully equipped for night flying, and are maintained by Jersey Airlines.

● Apart from the loss of its Tiger Moth, which landed on a hangar roof on a first solo flight, the Edinburgh Flying Club reports cheerfully on the start of the New Year, and a satisfactory flying conclusion to the Old. December gave one of the best flying totals to date, and the Chipmunk is carrying on pending the arrival of another aircraft.

● Despite overcast, gales, fog and snow, the Exeter Aero Club maintained a steady daily flying time in January. Several of its members are undergoing training for their C.P.L.s; and one P.P.L. aspirant soloed in January.

● The Oxford Aeroplane Club reports that despite the unfortunate change in the weather, well over 2,000 hours were flown in 10 months from March, 1959, when the club was re-formed. Interesting whispers have been heard from the company office about some new aircraft for the coming season. Winter lectures are continuing and members, friends and neighbouring clubs are welcomed.

● From Biggin Hill comes news of more creature comforts in the clubhouse of the Surrey and Kent Flying Club. It now boasts television and extra heaters. Instruction is now available on the Maitland Air Charter D.4 Link Trainer, at 25s. an hour. During December, 118 hours were flown (in the air, not the Link), and three members made first solos.

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Never before, since the relaxation on importing light aeroplanes, have so many desirable aircraft been available to the British private pilot and executive operator. The only snag, as W. S. Shackleton, Ltd., the well-known aircraft dealers, have pointed out, is deciding which one to choose.

To help prospective clients, Shackletons have produced two small booklets, entitled "Your Own Aeroplane." In these, they have assembled all the British and all the foreign light aircraft types currently available, with photographs, descriptive matter and technical specifications of each. About three dozen American, Belgian, Czech, French, German, Italian and Swedish aircraft are covered in the foreign brochure, while information on some 16 British types is included in the other.

The booklets, which are printed on art paper and in a handy size for the pocket, are very well produced and are right up to date, with such aircraft as the Piper Aztec and the "swept" Cessnas represented. They are available free of charge to Shackleton clients, but anyone else interested can obtain copies at their cost price.

Gliding Notes

by Dr. A. E. Slater

SOUTH Africa's National Championships, held at Kimberley, have been won by E. Dommisse, usually known as "Boet," for the fourth time. He flew a different machine on each occasion: Minimoa, Kranich, Moswey 4, and now Skylark 3b.

This time Dommisse put up the first South African record for speed round a 300-km. triangle, averaging 46.13 m.p.h. (74.24 k.p.h.). This was on Jan. 6, the last day but one, with light winds and ½ to ¾ cumulus the bases of which were at 10,000 ft. Four others finished the course that day: Tim Mowat-Biggs in a French Air-100, Geoffrey Green in a Slingsby Skylark 1, Heini Heiriss in a German Ka-6, and Hans Jordan in a Swiss Moswey 4.

But a less simple technique was needed a week earlier, when Dommisse tried the same task. This time the third leg was straddled by a storm, but Dommisse avoided it by getting 22,000 ft. on the second leg, gliding round the second turning-point and returning to the active second leg to gain height again for a glide home, which he missed by only a few miles.

Skylarks occupied the first four places at the finish. "Boet" Dommisse won with 939 points; Edwin Leeman earned 930 with another Skylark 3b, and the Skylark 1 was shared by Peter Leppan with 807 and Geoffrey Green with 776 points. A 300-km. goal flight earned a Diamond for Eric Kaizer in a Slingsby Swallow and helped him to finish eighth. The Junior Championship was won by H. Oberhofer in a Swiss S-18.

AT a board meeting of OSTIV held in early February, the timetable of the next Congress was fixed. It will open on June 7 at 11.00 hrs. in Cologne. After that the sessions will be held nearby at Butzweiler, where the World Gliding Championships will be going on. Technical sessions will be on June 9-11, and meteorological sessions on June 15-17. Between will come the General Conference on June 14. Technical papers should be sent beforehand to the Secretariat at Kanaalweg 3, The Hague, Holland.

Also to be sent to the Secretariat are particulars of entries for the OSTIV Prize for the best Standard Class sailplane of 1960. They must be in by May 15, and draft specifications can be had from the Secretariat. The jury will need two days to inspect the entries, and will also want to fly them in the early morning before competition flights start. Those specially interested in the Standard Class should note that a "working group" will be discussing it on June 4 and 5 at Butzweiler.

The Russian team for the World Championships will not, this time, include the Kiev opera singer, Victor Goncharenko. This is a pity, as he was the best of the four Russian pilots who competed in Poland in 1958. It appears that he had the misfortune to break a wing when landing in a millet field during the elimination trials.

• • •

NORFOLK and Norwich Aero Club, which used to run a gliding section in pre-War days now has one again. Alfred Warminger went to Denmark to collect the fleet, which consists of an Olympia and a Kranich, bought from the Gothenburg Gliding Club in Sweden. He took his own trailer over on the Harwich-Esbjerg ferry to pick up the Olympia, while the Kranich already had an excellent trailer made of steel tubes. Both machines are in good condition.

Ab initio pupils will have to learn to fly with engines on the club's Tiger Moths for five hours before flying without them in the Kranich, in which they will have about 10 aero-tows before going solo on the Olympia. It is to be hoped that this will work better than in pre-War times, when the most dangerous people on the club's Kestrel sailplane were found to be "experienced" aeroplane pilots.

Incidentally, the club site at Swanton Morley is a good starting-place for long-distance flights in the April north-easterlies, and visitors will be welcome.

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THE "Standard Austria," as its name implies, is a new 15-metre for the Standard Class; it is designed by Rüdiger Kunz, and has gone into production after a thorough testing of the prototype. It has a V-tail and a rather pointed nose. Metal is used in the wings to maintain the shape for laminar flow.

The best gliding angle is 1 in 34 at 105 km.p.h. (65 m.p.h.); minimum sink is 0.7 m. (2 ft. 3½ in.) per sec. at 70 km.p.h. (43.5 m.p.h.); and minimum flying speed 34 m.p.h. Wing loading is 4.5 lb./sq. ft.

Correspondence

Proof of Airworthiness

YOUR correspondent, Mr. D. Woodward (Feb. 5), expresses the view that small aircraft companies are at a disadvantage, in that they have to prove that the aircraft they are building is safe. He advocates the reverse situation should apply, namely, the onus should be on the Air Registration Board to prove it is unsafe. Mr. Woodward believes this reversal of the situation would substantially reduce the costs which face the constructor.

The implication is that, left to make his own decisions, the constructor would not do many of the tests and calculations which the Board requires him to do. The designer would rely to a great extent on his judgment that safety requirements were met without making the tests, etc., to substantiate his beliefs. While in many instances the designer's judgment is confirmed by subsequent tests, in some cases a test reveals unexpected and serious inadequacies. Thus while a reduction of the scope of effort in proving would undoubtedly reduce initial costs, it is also quite certain that the resulting aircraft would be less safe.

Whether the advent of less safe aircraft would be welcomed by the users is a moot point. Although initial costs might be less, the running costs (i.e., increased insurance premiums) might well offset these smaller first costs.

On the basis that evidence rather than instinct is a necessary feature of safety, the question of onus of proof becomes irrelevant. The Board's Surveyors could not "prove" that a design was unsafe—without tests to substantiate the matter—any more than a designer can prove the aircraft is safe in the absence of the self-same tests. Thus, wherever the onus of proof lies, proof means evidence, evidence means tests and calculations, and these inevitably involve cost. Presumably Mr. Woodward does not imagine the Board has a secret store of wealth to subsidize the constructor.

On a point of detail, your correspondent suggests that it is not usually the case for the Board to be actively helpful. I will not seek space in your columns to print the unsolicited testimonials which indicate an opposite viewpoint. Perhaps it is sufficient to say it is easier to help those who accept a reasonable view of their own responsibilities. It is also a fact that the Board's investigation costs are relatively greater with small aircraft than with large, because the Board tries to help the designer whose staff and facilities may be barely adequate for the tasks undertaken.

London, W.C.2. R. E. HARDINGHAM,
Chief Executive, Air Registration Board.

Where the Ferries Went

IN your issue of February 5 Mr. L. Morgan wonders what happened to the Airspeed Ferries. He may be interested to know that G-ABSI C/N4 in 1940 was taken over by the R.A.F. as AV968 and later became 2758M. G-ABSJ C/N5 was sold as VT-AFO Q-3A. In 1936, the wooden fuselage fell prey to the ravages of the white ant. G-ACBT C/N6 was dismantled at Renfrew during the War.

G-ACFB C/N9, the C. of A. of which expired on November 21, 1938, remained picketed at Heston until finally taken by road to an A.T.C. Sqn. at Stoke-on-Trent in 1941.

St. Albans, Herts. R. PINNOCK.

[Mr. Pinnock's information is reproduced from "British Civil Aircraft, 1919-59," by A. J. Jackson. A "C/N" is a constructor's number.—ED.]

The Modest Americans

IT is not only the "Popular Press" (attacked in "Achievements in Space Research," THE AEROPLANE AND ASTRONAUTICS, January 15) that gives a distorted picture of the advent of astronautics in our era. Take Dr. Homer Newell's report, which served as the principal source for your survey of 15 years of astronautical developments in the U.S.A. and the U.S.S.R. You copied from his report (NASA release No. 59-277, December 15) only part of Table 2, omitting one field, Upper Atmosphere (which covered three pages) completely, for no apparent reason.

I would rather not go into that, however, but would draw your attention to Table 1 of the same report: Significant firsts in sounding rocket, satellite, and space probe research. Dr. Newell lists as a Russian first: "6. First routine recovery of large animals (dogs and rabbits) from high altitude rocket flights." This "first," undated by Dr. Newell, must have been scored several years after the real—and American—first in this field. I quote from a March 16, 1959, Aerojet General Corporation news release: "In 1953 the Air Force used an Aerobee-Hi to carry mice and monkeys for the first time to an altitude of 60 miles. The animals were recovered and are now in the Washington, D.C., Zoo."

On the same subject, the *Aerojet Rocket Review* said recently: "An Aerobee was the first high-altitude sounding rocket launched from a naval vessel. It was also the first vehicle used to transport mice and monkeys to an altitude of more than 60 miles. This historic flight demonstrated the ability of animals to withstand the force encountered during a manned rocket flight."

Among the several other American firsts Dr. Newell "overlooked" are: Establishment of Earth satellites in polar orbits; establishment of Earth satellites in near circular orbits; ejection of capsules from orbiting "polar" Earth satellites; use of an orbiting Earth satellite as a communications relay station; changing of altitude (by remote control) of an orbiting Earth satellite.

One only wonders what—or who—prompted Dr. Newell to "forget" these significant "firsts" when he prepared his list. One also wonders what made him—and the scientific and trade journals—readily accept (without scientific proof) every Russian space claim, including the wildest ones.

Rotterdam, Holland. J. A. REDEKER.

[Limitation of space was the reason for omitting Dr. Newell's tables on The Upper Atmosphere. We drew attention to the early American experiments with animals in our issue of June 5, 1959, p. 655. ("Two monkeys and two mice were recovered in good health after travelling to a height of 200,000 ft. in Aerobee rockets in 1952."). In awarding top marks to the U.S.S.R., we can only assume that Dr. Newell was concerned with "first routine recovery" of rocketed animals (his own wording). Few would deny that the Russians have developed the recovery of dogs to a high art over the past few years, or indeed that the Americans, in their ballistic experiments with monkeys, have also made great progress.

The achievement by the U.S.A. of an "elementary communication link tested in Project Score" is, in fact, listed by Dr. Newell under "Engineering Data" (Jan. 15, page 71). As regards polar orbiting satellites, near-circular orbits, ejection of capsules, satellite orientation, etc., these "firsts" were attributed to the Americans in our article, "Lockheed Discoverer Project," published on January 1 last.—ED.]

Groundabout

Busy Line. Such is the emphatic trend of design and construction up at Avro's Manchester factory that I shouldn't wonder if they changed their telephone number from Failsworth 2020 to Failsafe 748.

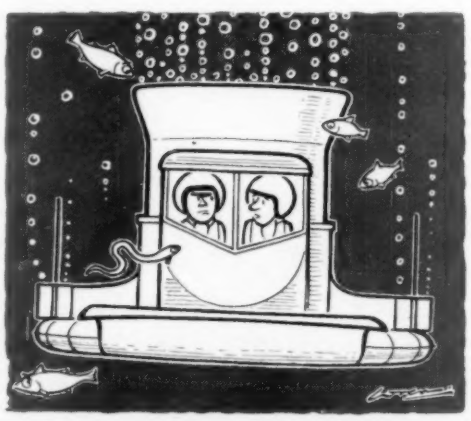
★

My Aching Feet. Stewardess: "I don't know why there's all this fuss about Dr. Barbara Moore walking from John o' Groats to Land's End—I walked from New York to London today."

★

Mass Travel. The heaviest passenger ever carried by Tasman Empire Airways—or any other airline, I should think—was Mr. Fitismanu, a Western Samoan whose 36 stone (504 lb. to American readers) was recently uplifted by them. Actually, he's the chap who always occupies the seat next to me when I travel Economy Class.

★



"Sorry—I must have put her into reverse."

by Gregg

Industry Record

Sophisticated Flight Control

The Sperry SP-30 flight control system, which was cleared last month by the Federal Aviation Agency in the form developed for use in the DC-8, has a number of significant new features. Most interesting of these is the use of accelerometers to provide sensitive corrections in conjunction with the more normal gyro displacement corrections provided by the system. To this extent, therefore, the SP-30 can be considered to incorporate inertial principles and the work of the acceleration sensing devices is, in fact, described by Sperry as "inertial path damping." The DC-8 is the first civil transport to be equipped with this system.

So far as pilot operation is concerned, the autopilot has two modes, one of which provides fully automatic flight, while the other is primarily a yaw damper, but also provides "stability augmentation" in all three axes when the aircraft is being flown manually. Maximum servo force, automatic and manual, is limited and the sub-systems for each axis are self-contained and isolated. In addition to the normal pitch and altitude-holding functions, the elevator system includes constant-airspeed and constant-Mach control.

The Sperry integrated instrument system is now an integral part of the flight control/autopilot system and the same gyros and heading selector are used.

Air-conditioning Equipment

Having manufactured various types of pressurized component assembly cabinets for a number of years and constructed clean air rooms for companies in the guided-missile and instrumentation fields, John Bass, Ltd., of Crawley, have now developed a prototype "Mancleaner." This unit, designed to decontaminate personnel entering, or leaving, filtered-air and temperature-controlled rooms, is a compact, self-contained plant for removing minute particles of dust from over-garments.

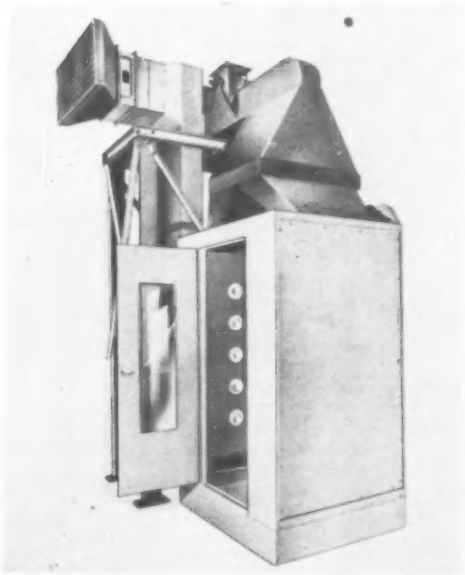
The cleansing chamber itself has two doors, allowing the operator to enter at one end for cleaning and to leave at the opposite end clean for entry into an air-controlled area. The mechanism controlling the direction and volume of air sprayed into the chamber is built into its sides. The fan, motor, heater tank, filters and the instrument panel carrying all control switches are mounted on a gantry standing at the side of the chamber.

When an operator enters the chamber dressed in protective clothing he, or she, is intermittently sprayed with clean air approximately 5° F. above the surrounding temperature. By this means any dust or foreign matter on the garments is disturbed, the spraying process is then reversed and the dust is sucked off and discharged by means of built-in ducting to the ambient air.

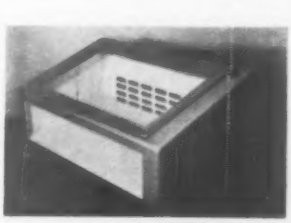
The company's clean room is designed both to prevent the entry of contaminents into the working area, and to remove those generated within the area. It is therefore slightly pressurized in order to prevent inward draughts of air and to eliminate the particles that are discharged into the atmosphere as a result of movement within the room. Filtration can be obtained to 0.5 micron and constant temperatures can be controlled to an effective differential of 2° F., allowing a range of appropriate conditions to be selected.

Among the electronic and instrument manufacturers who have complete John Bass clean-room installations are English Electric and the General Electric Co.

Now included in the company's standard range of pressurized assembly cabinets are bench models for use on assembly lines; a vacuum cabinet with a hermetically sealed air lock equipped with quick-action doors; and a pathological cabinet. Basically, all these cabinets employ a fan which draws air into the working area through a filter, and as the outlet is smaller than the channel of air inside, it is slightly pressurized. This prevents airborne pollution from entering through the front or work aperture of the cabinet, and forces to the bottom any particles which may be inside.



The Bassaire Mancleaner unit (left) produced by John Bass, Ltd., of Crawley, Sussex. An operator enters the cubicle dressed in protective clothing and is intermittently sprayed with clean air approximately 5° F. above the surrounding temperature. Below, a bench-type pressurized assembly cabinet designed primarily for use on assembly lines.



The repair and overhaul of liquid oxygen breathing system components installed in NATO aircraft is undertaken by British Oxygen Aro Equipment, Ltd. Here five-litre liquid oxygen converters are seen undergoing high-vacuum testing at the company's works at Harlow.

Canadian Doppler Performance

Since the article on Canadian Marconi Doppler equipment in our issue of October 2, 1959, the company has released some guaranteed performance figures. These state a ground speed accuracy of better than 0.6%; a drift error of less than ¼°; and a total time in "memory" of less than 2% of the actual operating period.

This performance accuracy has been obtained by the company from the results of the first year of service with the equipment.

Titanium Heat Treatment

Development of a heat treatable titanium sheet alloy together with a new process for heat treatment have been announced by the Republic Steel Corpn., of Ohio. The new heat treated titanium sheet is stated to be of particular interest to the aircraft industry, since it can be utilized in thinner gauges, and therefore lighter weight, while still holding the required strength ratings.

Applications in which heat treated titanium can be utilized in aircraft or missiles include skins, stiffeners, internal structures, engine nacelles, bulkheads, and as heat shields. Another application in which heat treated titanium is thought to offer a substantial weight saving over other materials is for cover sheets on honeycomb sandwich-type panels.

For its new heat treatment process, Republic Steel is using a five-zone electrically heated continuous roller hearth furnace, especially adapted to deliver uniformly heated sheets directly into a continuous roller quenching unit. This furnace provides for a high degree of uniformity of heating, with temperature control in each zone of ±10° F.

In this heat treatment process titanium sheets, which have been specially precoated to prevent contamination by atmospheric gases, are heated for short periods to a temperature between 1,400° F. and 1,700° F., depending upon the alloy grade. This is followed by water quenching in a continuous roller

Industry Record . . . .

The Argentine Air Attaché, Air Cdre. A. R. Sola Claret (third from left), accompanied by Air Cdre. W. C. Jansen and Air Cdre. G. L. Ballesteros visited the Sperry Gyroscope Co., Ltd., earlier this month. They discussed the latest developments in aircraft instrumentation and flight control.

quenching unit. Sheets treated with the coating can be cleaned without immersing in molten caustic, the conventional method used to descale titanium.

After being treated by this process the sheets are in the soft condition and may be either hot or cold formed, then "aged" for several hours at a temperature between 900° F. and 1,000° F. Known as Type RS-140, Republic Steel heat treatable titanium can be supplied in sheet sizes up to 48 in. x 120 in. and gauges as light as 0.01 in.

Aerodynamics Course

The 1960-61 one-year diploma course in experimental aerodynamics organized by NATO's Training Center for Experimental Aerodynamics in Belgium starts on October 3 and ends on July 1, 1961. Details from the Center at 72 chaussée de Waterloo, Rhode - Saint - Genèse, Belgium; applications must be made before March 19.

Change of Name

Saunders-Roe (Anglesey), Ltd., have announced that the name of the company has been changed to Saro (Anglesey), Ltd. The decision to make the change has been taken only to avoid any confusion which might arise between them and the firm of Saunders-Roe, Ltd., of Cowes, Isle of Wight, with whom they were formerly associated. There is to be no change in the board of directors.

Communication Equipment Orders

W. S. Electronics, Ltd., have been awarded a substantial contract from Switzerland for their airborne VHF communications transmitter/receiver to a value of approximately 1m. Swiss francs. Further pilot orders are in production for Italy and France. Following another development programme, W. S. Electronics have also commenced production on a £40,000 order from a leading British aircraft company for their new VHF telemetry transmitter which simultaneously transmits 12 separate channels of data on a single frequency.

PUBLICATIONS RECEIVED

Advances in Aeronautical Sciences Vols. 1 and 2.—Proceedings of the First International Congress in the Aeronautical Sciences in Madrid. Editorial committee chairman Th. von Kármán. 1,706 pp.; 6¼ in. by 10 in. Illustrated. Pergamon Press, Ltd. Price £2 set of two volumes.

Brassey's Annual "The Armed Forces Year-Book".—Articles on theories and opinions on strategical subjects, defence policy and administration in the Services. Edited by Rear-Admiral H. G. Thursfield. 424 pp.; 6 in. by 9¼ in. Illustrated. William Clowes and Sons, Ltd. Price 63s.

Soviet Sputniks and Cosmic Rockets.—By S. G. Alesandrov and R. E. Fedotov. 230 pp. Illustrated. Collet's list. Price 4s. 6d.

Aviation Calendar

February 19

Birmingham.—R.Ae.S. Birmingham and Wolverhampton Branch lecture "The Rolls-Royce Tyne Engine," by D. Maclean, at the Engineering Centre, at 19.30 hrs.

February 22

Manchester.—Institution of Production Engineers Manchester Branch lecture, "Radio in Space Research" by Dr. J. A. Saxton at Reynold's Hall, Manchester College of Science and Technology, Sackville Street, at 19.15 hrs.

R.A.F. Halton.—R.Ae.S. Halton Branch third Trenchard Memorial lecture, "A Dip into the Future . . .", by Sir George Edwards, in the Burnett Gymnasium, at 18.15 hrs.

February 23

London.—R.Ae.S. lecture, "Relationship between Theory and Practice in Structural Problems," by A. J. Troughton in the Library, 4 Hamilton Place, W.1, at 19.00 hrs.

London.—British Interplanetary Society lecture, "Some Problems Encountered in the Design of Large Rocket Test Beds," by R. H. B. Forster and L. Breen at the Royal Society of Arts, John Adam Street, W.C.2, at 19.00 hrs.

London Airport Central.—Institute of Transport West Middlesex Group lecture, "Aircraft of the Future," by R. C. Morgan in the Conference Room, 3rd Floor, Control Tower Building, at 18.30 hrs.

Salford.—Royal Technical College lecture, "Structural Aspects of Space Vehicles," by J. T. Henshaw at the Royal Technical College, at 19.00 hrs.

February 24

London.—R.Ae.S. Graduates' and Students' Section A.G.M. and Film Show, in the Library, 4 Hamilton Place, W.1, at 19.30 hrs.

London.—Kronfeld Club lecture, "Hunters," by A. W. Bedford, in the Basement, 74 Eccleston Square, S.W.1.

Christchurch.—R.Ae.S. Christchurch Branch lecture, "Man-powered Aircraft," by D. S. Shenstone, at the Kings Arms Hotel, at 19.30 hrs.

Hatfield.—R.Ae.S. Hatfield Branch lecture, "The SR-N1 Hovercraft," by R. Stanton-Jones, in the de Havilland Restaurant, at 18.15 hrs.

Reading.—R.Ae.S. Reading Branch lecture, "The Car Ferry Operation and History of Silver City Airways," by M. D. Day, in the Top Canteen, Western Manufacturing (Reading), Ltd., at 18.00 hrs.

February 25

London.—Aerodrome Owners Association Annual General Meeting and Dinner, at the Hyde Park Hotel, S.W.1, at 16.00 hrs. and 19.30 hrs. respectively.

Belfast.—R.Ae.S. Belfast Branch lecture, "Blind Landing," by W. J. Charnley, in the Lecture Hall L.G.8, David Keir Building, Queen's University, at 19.00 hrs.

Bristol.—R.Ae.S. Bristol Branch Junior Committee lecture, "The SR-N1 Hovercraft" by R. Stanton-Jones, at Filton House, at 18.00 hrs.

Cowes.—R.Ae.S. I.o.W. Branch lecture, "The Economic Basis for the Design of a Freight Aircraft," by A. H. Stratford, at the Saunders-Roe Sports and Social Club, Church Path, at 18.00 hrs.

Company Notices

INCREASES OF CAPITAL

Dan-Air Services, Ltd. (519,947). 36-8 New Broad Street, E.C.2.—Increased by £95,000 in £1 ordinary shares, beyond the registered capital of £5,000.

Surrey Aviation, Ltd. (536,866). Croydon Airport, Surrey.—Increased by £200, in £1 ordinary shares, beyond the registered capital of £1,100.

Trans African Aircoach, Ltd. (615,970).—19 Grand Arcade, Trafalgar Square, W.C.2.—Increased by £100 in £1 shares, beyond the registered capital of £100.

New Patents

APPLICATIONS ACCEPTED

831,030.—Bulow, K. O.—"Towable air-targets."—Feb. 3, 1958. (Feb. 4, 1957 (2).)

830,816.—De San. M. G. L. M. J.—"Propulsion of vehicles."—Dec. 17, 1957. (Dec. 17, 1956.)

830,982.—Soc. National d'Etude et de Construction de Moteurs d'Aviation.—"Jet-propulsion units with two or more coaxial motive flows."—June 27, 1957. (July 11, 1956.)

Printed specifications of the above will be available March 23, 1960, and the opposition period will expire on June 23, 1960.

831,683.—Air Trainers Link, Ltd., formerly Air Trainers, Ltd.—"Control - conditioning devices, especially for the controls of aircraft and flight trainers."—April 19, 1956. (April 28, 1955.)

831,380.—United Aircraft Corporation.—"Aircraft sustaining or propelling blades."—May 9, 1958. (June 17, 1957.)

831,508.—United Aircraft Corporation.—"Rotor blades for rotary wing aircraft."—Dec. 3, 1956.

831,472.—Martin-Baker Aircraft Co., Ltd., and Martin, J.—"Ejection seats for aircraft."—Feb. 20, 1958. (Feb. 22, 1957.)

Specifications of the above will be available on March 30, 1960, and the opposition period will expire on June 30, 1960.

Personal Notices

BIRTHS

Durward.—On February 2, at R.A.F. Jever, to Patricia (*née* Sewards), wife of Flt. Lt. A. G. Durward—a daughter.

Halliwell.—On February 5, at Crowtree Hospital, Louth, to Irene (*née* Meredith), wife of Sqn. Ldr. S. Halliwell—a daughter.

Hutchinson.—On February 6, at Royal Oak, Crondall, Hampshire, to Susan (*née* Roe), wife of John Chester Hutchinson, R.A.F.—a son.

Jones.—On February 1, at the Louise Margaret Maternity Hospital, Aldershot, to Patricia (*née* Routledge), wife of Flt. Lt. Neville Jones—a daughter.

O'Donnell.—On February 7, at The Canadian Memorial Hospital, Taplow, to Monica Joan (*née* Surfleet), wife of Wg. Cdr. Godfrey Cathbar O'Donnell, O.B.E., D.F.C., A.F.C., R.A.F. (retd.)—a son.

Price.—On January 31, at the Louise Margaret Maternity Hospital, Aldershot, to Sally (*née* Tal Amo), wife of Sqn. Ldr. R. G. Price—a daughter.

Thorman.—On January 27, at Newark, to Liz (*née* Young), wife of Flt. Lt. C. N. P. Thorman—a son.

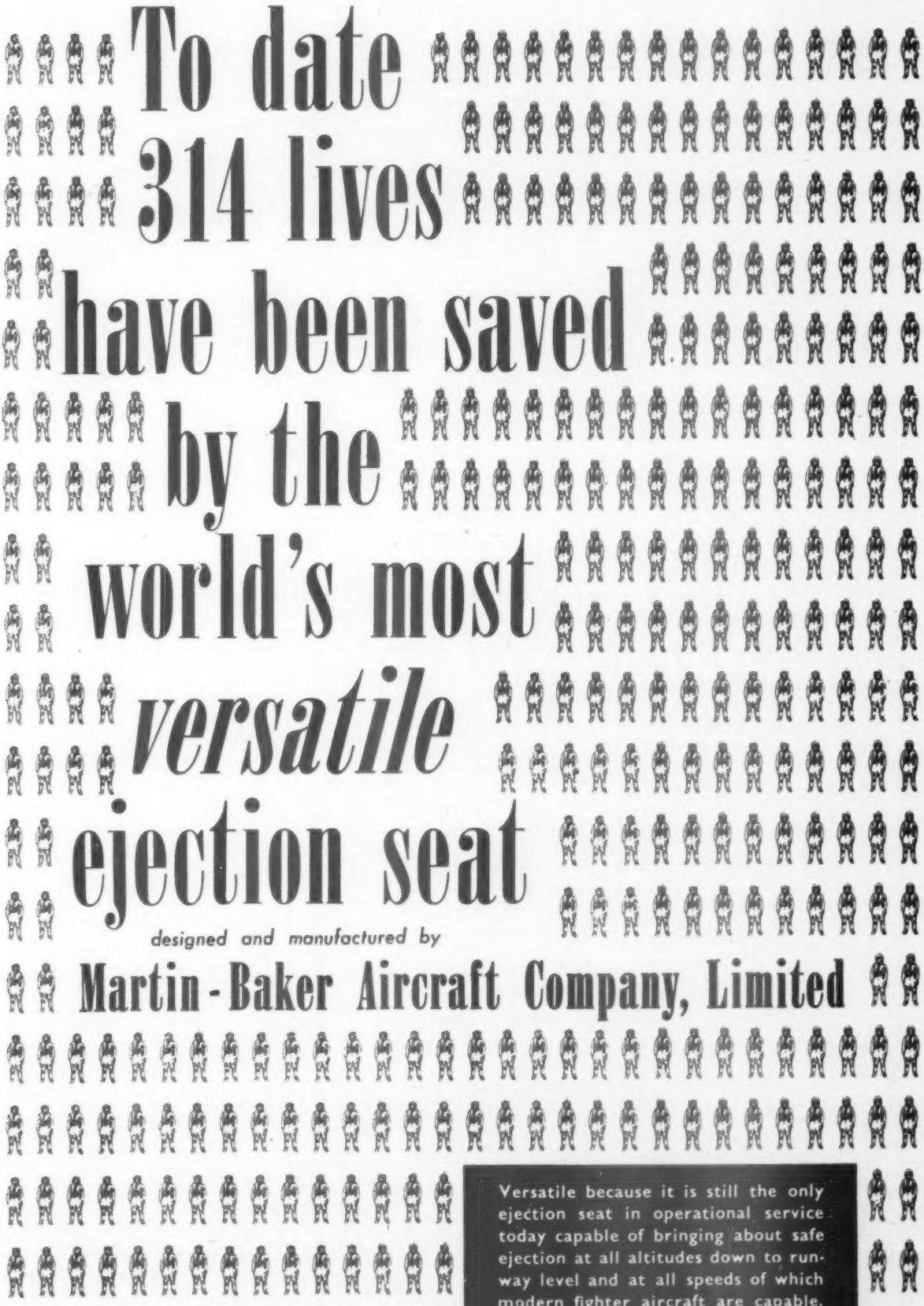
Thornalley.—On February 1, at Westwood Maternity Hospital, Peverley, to Fay (*née* Jefferson), wife of Flt. Lt. G. B. Thornalley, of R.A.F. Duxford—a daughter.

Wood.—On February 3, at Queen Charlotte's Hospital, London, W.6, to Patricia (*née* Mescall), wife of Sqn. Ldr. Charles Wood, R.A.F., Waddington, Lincoln—a daughter.

DEATHS

Deane.—On February 1, Gp. Capt. W. W. Deane, C.B.E., R.A.F. (retd.)

Sueter.—On February 4, Rear Admiral Sir Murray Fraser Sueter



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NOTICES

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM DAN-AIR SERVICES, LTD., OF 36-38 NEW BROAD STREET, LONDON, E.C.2, for the following U.K. Internal Services (unless otherwise stated), with Dove and Dakota aircraft, for the carriage of passengers, supplementary freight and mail, at a frequency of four return flights weekly on each service, for seven years from April 1, 1960:—

APPLICATION NO. 3391 between Plymouth and Bristol (Lulsgate).

APPLICATION NO. 3392 on the route Plymouth and/or Cardiff and/or Bristol (Lulsgate)-Liverpool.

APPLICATION NO. 3393 on the route Plymouth and/or Bristol (Lulsgate)-London (Gatwick) or London Airport.

APPLICATION NO. 3394 for a Normal Scheduled Service between Plymouth and Dinard.

APPLICATION NO. 3395 between Plymouth and Jersey.

APPLICATION NO. 3396 between Plymouth and Birmingham.

APPLICATION NO. 3397 on the route Plymouth and/or Bristol and/or Cardiff-Isle of Man.

FROM B.K.S. AIR TRANSPORT, LTD., OF BERK HOUSE, BAKER STREET, LONDON, W.1:—

APPLICATION NO. 1621/1 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate with Dakota and Ambassador aircraft on the route Southend and/or London Airport-Bordeaux or Dinard (tech)-Oporto, at a frequency of two return flights weekly, increasing in accordance with traffic demand, until October 31, 1965, so as to enable them to operate on the amended route Southend and/or London-Bordeaux or Dinard (tech)-Oporto-Madeira (opt.).

FROM EAGLE AIRWAYS, LTD., OF 40 EDGWARE ROAD, LONDON, W.2:—

APPLICATION NO. 373/8 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate on the routes London-Innsbruck and London-Luxembourg-Innsbruck, at a combined frequency of not more than 14 return flights weekly with Heron, Dakota or Viking aircraft (Viscount and DC6C aircraft also being permitted to be used at half that frequency, except that DC6C aircraft may not be operated on the route London-Luxembourg-Innsbruck at a frequency exceeding three return flights weekly) so as now to permit them on the direct route London-Innsbruck only to operate at a frequency in accordance with traffic demand.

APPLICATION NO. 3400 for a U.K. Internal Service and Helicopter Service initially with Viking, Viscount and DC6C aircraft and later also with Helicopter aircraft for the carriage of passengers, supplementary freight and mail between London Airport and Manchester, at an initial frequency of three return flights daily increasing later to six return flights daily, for 10 years from date of approval.

FROM EAST ANGLIAN FLYING SERVICES, LTD., OF SOUTHEND AIRPORT, ESSEX:—

APPLICATION NO. 4/10 for permission to carry supplementary freight on the U.K. Internal Service which they are authorized to operate on the route Ipswich - Southend - Rochester - Shoreham - Alderney-Guernsey-Jersey, until March 31, 1967.

FROM BRITISH OVERSEAS AIRWAYS CORPORATION, OF LONDON AIRPORT, HOUNSLOW, MIDDLESEX:—

APPLICATION NO. 142/1 for extensions of the periods of approval of the following Normal Scheduled Services for seven years from the dates shown:—

London-Zurich-Rome-Mafraq or Amman-Baghdad from March 31, 1960 (Application No. 142).

London-Geneva or Dusseldorf or Frankfurt-Rome-Nicosia (tech.)-Beirut from March 31, 1960 (Application No. 153).

Inclusion of a traffic stop at Geneva as an alternative to Zurich on Reserved Route No. 2: London-Tokyo, from April 9, 1960 (Application No. 155).

Inclusion of a traffic stop at Dusseldorf as an alternative to Frankfurt on Reserved Route No. 5: London-Hong Kong, from April 9, 1960 (Application No. 156).

Inclusion of a traffic stop at Geneva or Zurich as an alternative to Frankfurt on Reserved Route No. 5: London-Singapore-Hong Kong and/or Tokyo, from April 9, 1960 (Application No. 157).

Inclusion of a traffic stop at Nicosia on three services weekly, in each direction on Reserved Routes Nos. 2, 3, 4, 5 and 6 from London to Bombay, Colombo, Tokyo, Hong Kong and Singapore, from March 31, 1960 (Application No. 167).

Inclusion of a traffic stop at Dusseldorf or Geneva as an alternative to Frankfurt on Reserved Route No. 9: London-Baghdad, from March 31, 1960.

APPLICATION NO. 3401 for permission to include optional traffic stops as stated on the following Reserved Routes:—

Melbourne as an optional traffic stop and terminating point on Reserved Route No. 1: London-Sydney.

Zurich as an alternative to Frankfurt or Dusseldorf on Reserved Route No. 3: London-Hong Kong, and Reserved Route No. 4: London-Singapore.

Abadan on Reserved Route No. 10: London-Kuwait and/or Bahrein and/or Doha.

APPLICATION NO. 339/4 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate until October 31, 1961, on the route London-Frankfurt or Zurich-Rome-Nicosia or Beirut and/or Damascus or Cairo-Istanbul (opt.)-Teheran (opt.)-Baghdad (opt.)-Basra (opt.)-Kuwait (opt.) Bahrein (opt.)-Doha (opt.)-Abadan and or Karachi, so as to enable them to include a traffic stop at Dusseldorf as an alternative to Frankfurt or Zurich and to extend the route to include Delhi and Calcutta as optional terminating points.

Continued at top of next classified column

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Continued from previous classified column

These applications will be considered by the Council under the terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 522-2

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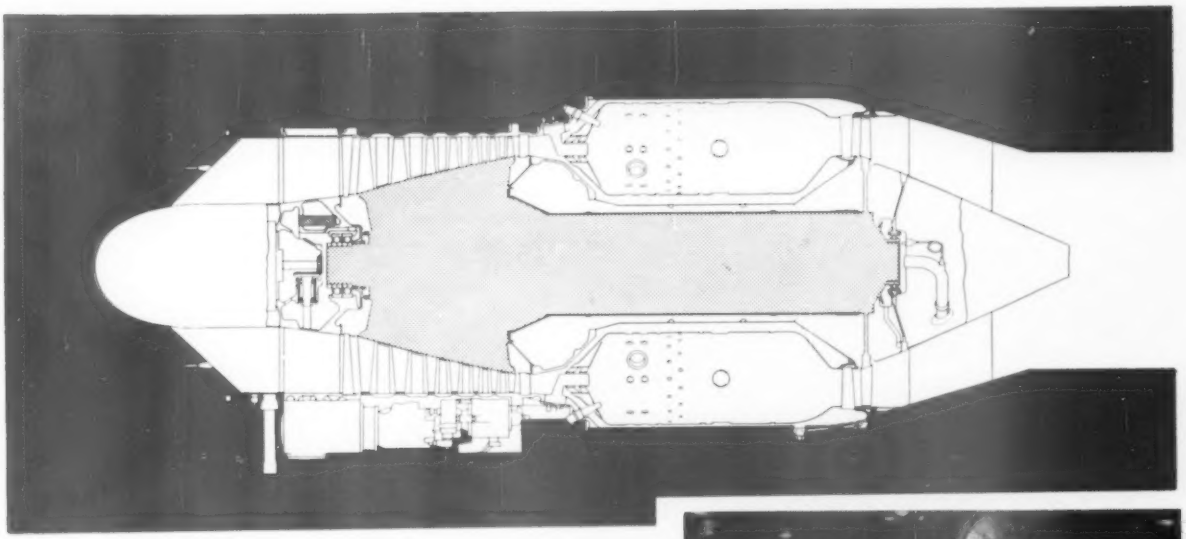

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